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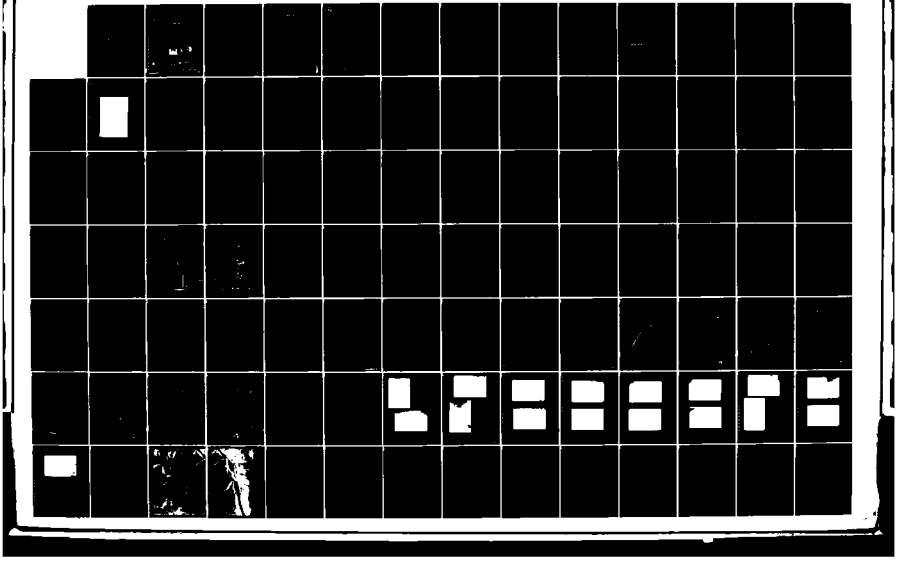

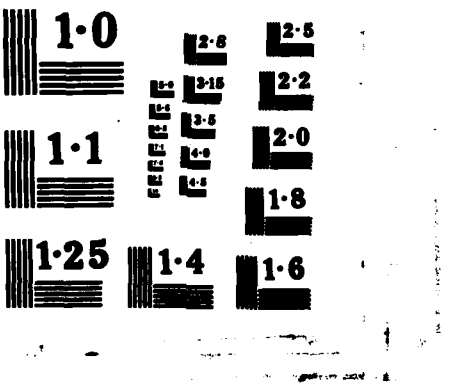
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CONNECTICUT RIVER BASIN
SHERBURNE, VERMONT

KENT POND DAM
VT 00071

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Sherburne, VT.
Kent Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is an earthfill embankment about 1450 ft. long and 26.5 ft. high. The dam is considered to be in fair condition. It is intermediate in size with a significant hazard potential. The test flood is equal to ½ the PMF. There are various recommendations which should be implemented by the owner.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

AUG 0 6 1981

Honorable Richard A. Snelling
Governor of the State of Vermont
State Capitol
Montpelier, VT 05602

Dear Governor Snelling:

Inclosed is a copy of the Kent Pond Dam (VT-00071) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Management and to the owner, Department of Fish and Game, Agency of Environmental Conservation, Montpelier, VT. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Management for your cooperation in this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

CONNECTICUT RIVER BASIN

SHERBURNE, VERMONT

KENT POND DAM

VT 00071

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASSACHUSETTS 02154

FEBRUARY, 1981

LETTER OF TRANSMITTAL

FROM THE CORPS OF ENGINEERS TO THE STATE

TO BE SUPPLIED BY THE CORPS OF ENGINEERS

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Identification Number:	VT 00071
Name of Dam:	KENT POND DAM
Town:	SHERBURNE
County and State:	RUTLAND COUNTY, VERMONT
Stream:	KENT BROOK
Date of Inspection:	AUGUST 6, 1980

The dam, constructed in 1965, is an earthfill embankment approximately 1,450 feet long and 26.5 feet in height. The upstream and downstream slopes are inclined at 3 horizontal to 1 vertical. The dam contains no drainage blankets or toe drains. The outlet structure is a reinforced concrete box 10 feet square in plan by 22.5 feet deep. The upstream end is fitted with stoplogs to a depth of 6 feet below the top of the structure. The outlet pipe is a 36-inch reinforced concrete pipe; the pond drain is a 12-inch valved cast iron pipe. The remote reinforced concrete emergency overflow spillway is approximately 80 feet long with a crest elevation 1 foot above the normal crest of the service spillway stoplogs.

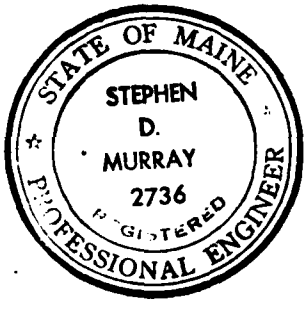
The dam impounds Kent Pond and the discharge flows in a northeasterly direction approximately 4,800 feet to its confluence with the Ottauquechee River. The pond is 2,800 feet in length with a surface area of 102 acres. Storage capacity at the top of the dam elevation is 1,160 acre-ft.

Based upon the visual inspection and the review of available data regarding this facility, the dam is considered to be in FAIR condition. No evidence of structural instability was observed, but three possible seepage areas were noted, the source of which could not be determined because of recent heavy rains.

In accordance with the Corps of Engineers Guidelines and the size (INTERMEDIATE) and hazard (SIGNIFICANT) classification of the dam, the Test Flood selected was equivalent to one-half the Probable Maximum Flood (PMF). Peak inflow to Kent Pond is 4,200 cfs; routed peak outflow from the dam and remote emergency spillway is 2,900 cfs with the water elevation 0.2 feet above the dam crest. Total spillway and outlet capacity is 2,800 cfs, which is equivalent to 97% of the routed Test Flood outflow.

It is recommended that the owner engage a qualified, registered engineer to inspect the dam during dry weather to assess the significance of the wet areas observed downstream of the dam. This, and the remedial measures which are discussed in Section 7, should be instituted within one year of the owner's receipt of this report.

Stephen D. Murray, P.E.
Project Manager
James W. Sewall Company



This Phase I Inspection Report on Kent Pond Dam (VT-00071) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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SECTION 4: OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General - No operating procedure, as such, is known to exist.

b. Warning System - No warning system is known to exist.

4.2 MAINTENANCE PROCEDURES

a. General - The dam receives no regular maintenance.

b. Operating Facilities - The stoplogs on the control structure are replaced as they deteriorate. The existing stoplogs appear to be in good condition.

4.3 EVALUATION

The operation and maintenance procedures at this dam are minimal but do not appear to have resulted in any difficulties. Nevertheless, a formal program of operation and maintenance procedures should be developed, including documentation to provide complete records for future reference. In addition, a formal warning system for the primary impact area should be developed and established.

d. Reservoir Area - There are no indications of instability along the banks of the reservoir in the vicinity of the dam.

e. Downstream Channel - There are two downstream channels, one downstream from the outlet pipe from the control structure, and one downstream from the emergency spillway. The two downstream channels are referred to as the outlet channel and the spillway channel, respectively, in the following sections.

The floor of the outlet channel is covered with cobbles and boulders as shown in photo 14. The channel is unobstructed to about 35 ft. downstream from the outlet pipe. Downstream from this point small trees overhang the channel.

The spillway channel is lined with riprap consisting of boulders and pieces of blasted rock as shown in Photo 15. From the downstream end of the concrete spillway to 60 feet downstream of this point the riprap stones are concreted together. There has been displacement and settlement of some rocks of the riprap. This movement is not considered to pose a problem at this time, but the area should be inspected perodically and following major storm events. Fallen trees and other debris were observed at the end of the spillway channel.

About 3,000 feet downstream from the dam is a light duty roadway bridge as shown in Photo 16. Between this bridge and the house shown in Photo 17, the brook channel becomes increasingly steep, leveling abruptly at the Ottauquechee River flood plain immediately downstream of the above house. Kent Brook enters the Ottauquechee River about 4,800 feet downstream from the dam. The Ottauquechee valley at this location is relatively flat, overgrown with bushes and shrubs, about 900 feet wide and nearly devoid of habitable structures. The river is little more than a brook at this location. Within 12,000 feet downstream of the confluence, three roadway bridges cross the Ottauquechee River.

3.2 EVALUATION

On the basis of the results of the visual inspection, Kent Pond Dam is judged to be in fair condition.

If the small trees and bushes on the upstream slope are allowed to continue to grow, the resulting root systems could create seepage paths which could lead to internal erosion of the dam.

The trees overhanging the outlet channel and the debris at the downstream end of the spillway channel could restrict the flow of water discharged into the channels.

A significant amount of rain fell at the dam site about 12 hours prior to the inspection. It was therefore not possible to determine if the wet areas observed downstream of the downstream toe of the dam were mainly the result of the rain or the result of seepage beneath the dam. The dam should be inspected by qualified engineers during dry weather in order to determine the presence of seepage conditions that could affect the stability of the dam.

1. At the contact of the downstream toe with the left abutment to about 150 feet right of the contact, Photo 6. The wet area extends from the downstream toe of the dam to about 150 feet downstream of the downstream edge of the crest.

2. At about Sta. 7+00 to about Sta. 8+00, Photo 7. The wet area extends from about 80 feet downstream from the downstream edge of the crest to about 120 to 150 feet downstream from the downstream edge of the crest.

3. At about Sta. 9+00 to about Sta. 10+00, Photo 8. The wet area extends from about 100 feet downstream from the downstream edge of the crest to about 140 feet downstream from the downstream edge of the crest.

c. Appurtenant Structures

Emergency Spillway

A concrete emergency spillway is located at the north end of the reservoir, about 2000 feet north of the east end of the dam, Photo 9. Any flow over the emergency spillway bypasses Kent Brook and flows north and east down a separate natural drainageway and intermittent stream which enters the Ottauquechee River about 3500 feet upstream of where Kent Brook joins the river.

The floor of the inlet channel to the spillway is covered with riprap. A concrete weir wall forms the 80-foot long crest of the spillway, as shown in Photo 10. There is a concrete slab 100 feet long forming the floor of the spillway, with concrete training walls on each side. The channel below the emergency spillway is rock riprap lined which for the first 60 feet has concrete mortar placed between the boulders. The sides of the emergency spillway channel are vegetated with grass and weeds. The natural slope above the channel is tree covered. The joints in the invert and sidewalls of the emergency spillway show no sign of difficulty. There are a few hairline vertical cracks in the vertical sidewalls from which there is a small amount of efflorescence but no indication of structural difficulty as shown in Photo 11.

Outlet Structure

The control structure is located on the upstream slope at about Sta. 4+30, Photo 12, and consists of a vertical concrete inlet shaft which leads to a 36-inch diameter outlet pipe. The rectangular shaft admits water on three sides. The side away from the dam is provided with stoplogs. The right and left sides have weirs to admit water. All visible concrete appears in good condition.

A gate valve and valve handle for the 12-inch pond drain are provided on the far side of this structure. The gate valve is reported to be operable. Access to the valve handle is along a 1½ inch galvanized pipe as seen in Photo 13, providing an insecure means of access, particularly during times of high water or freezing weather.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

At the time of inspection on August 6, 1980, the water level in Kent Pond, impounded by the dam, was 1 inch over the top of the stoplogs. The weather was warm, humid and overcast. The general condition of the dam is fair.

b. Dam - The dam is an earth embankment with approximately 3 horizontal to 1 vertical upstream and downstream slopes. Existing design drawings indicate the dam contains a reinforced concrete core wall along the centerline of the dam from about Sta. 2+00 to about Sta. 7+75. (The referenced station numbers were obtained from Haley and Ward, Drawing No. 2 - "Kent Pond Dam - General Plan of Proposed Dam", dated March 14, 1962). The plans indicate that the sections of the dam to the left and right of the concrete core wall section contain an impervious core along the centerline of the dam.

The dam is located at the southeast end of the reservoir. A reinforced concrete emergency spillway is located at the north end of the reservoir.

Upstream Slope

The upstream slope was covered with rip-rap full length to about elevation 1603 on the date of inspection, as shown in Photo 1. Above this level, the slope is grass-covered. Some bushes and small trees were observed on the upstream slope. There is a small quantity of accumulated debris along the shore. No animal burrows were noted.

Crest

The crest of the dam is about 20 feet wide with a 16-foot wide asphalt-paved roadway as shown in Photo 2. The remaining 4 feet of the crest is grass-covered. No erosion from storm runoff was noted.

Downstream Slope

The downstream slope is grass-covered as shown in Photo 3. The slope is separated into two sections by a knob of natural ground located at about Sta. 5+80. No animal burrows were noted.

The 36-inch diameter control structure outlet pipe passes from the control structure through the dam and exits at the downstream toe of the dam at about Sta. 4+30, Photo 4. As shown in Photo 5, a small rust-colored seepage area was observed adjacent to the left side of the outlet structure. This seepage did not appear to be the result of rain. The seepage was minor and of an undetermined quantity.

Wet, soggy areas with standing water and wetland flora were observed downstream of the downstream toe of the dam at the following locations:

SECTION 2: ENGINEERING DATA

2.1 DESIGN

a. Available Data - Available data consists of three sheets by Haley and Ward Engineers, Boston, Massachusetts; Sheet 2 of 10 - General Plan of Proposed Dam, March 14, 1962; Sheet 6 of 10 - Plan of Spillway and Sections of Embankment, May 1962; and Sheet 7 of 10 - Control Structure, March 14, 1962. Also available was a sheet by DuBois and King, Randolph, Vermont; Sheet 2 of 5 - Emergency Spillway, September 1973.

b. Design Features - The drawings, computations and inspection reports indicate the design features stated in Section 1.

c. Design Data - Design data consists of information on the drawings by Haley and Ward and on the drawing by DuBois and King.

2.2 CONSTRUCTION

a. Available Data - Information as contained in any plans, drawings, or specifications previously listed in "Design Data" or Appendix B.

b. Construction Considerations - No construction data was available for review. The dam is reported to have been built in 1965.

2.3 OPERATION

Pond level readings are not taken on any regular schedule. It is reported that the operating procedure consists of annual winter drawdowns by removal of some of the stoplogs.

2.4 EVALUATION

a. Availability - Existing data was provided by the State of Vermont Agency of Environmental Conservation, (the owner).

b. Adequacy - Detailed hydrologic/hydraulic data were not available. Design data and field measurements were utilized in conjunction with New England Division - Army Corps of Engineers "Preliminary Guidance for Estimating Maximum Probable Discharges" to perform the computations of outflow capacity.

The detailed engineering data required to perform an in-depth stability analysis of the dam was not available. The final assessment of the dam, therefore, must be based primarily on visual inspection, performance history, and spillway capacity computations.

c. Validity - A comparison of records, data, and visual observations reveals no significant discrepancies, other than those noted above, between design and as-built dimensions.

		Service	Emergency
6.	Downstream channel:	Original streambed	Rip-rap channel to streambed
7.	General:	N/A	N/A

j. Regulating Outlets

1.	Invert:	1581.0
2.	Size:	12" diameter
3.	Description:	C.I. low level drain
4.	Control mechanism	Manually operated gate valve
5.	Other:	N/A

f. Reservoir Surface

1.	Normal pool:	102 acres
2.	Flood control pool:	N/A
3.	Spillway crest:	102+ acres
4.	Test flood pool:	102+ acres
5.	Top of dam:	102+ acres

g. Dam

1.	Type:	Homogeneous earthfill
2.	Length:	1,450 ft
3.	Height:	26.5 ft
4.	Top Width:	20 ft
5.	Side Slopes:	3H to 1V
6.	Zoning:	N/A
7.	Impervious Core:	2 sections, one reinforced concrete, one clay
8.	Cutoff:	to ledge
9.	Grout Curtain:	N/A
10.	Other:	N/A

h. Diversion and Regulating Tunnel

i.

Spillway		Service	Emergency
1.	Type:	Stoplogs	Reinforced Concrete
2.	Length of weir:	6 feet	80 feet
3.	Crest el.	1601.0 (top of stoplogs)	1602.0
4.	Gates:	N/A	N/A
5.	Upstream channel:	N/A	Earthen

8.	Total project discharge at top of dam el. 1606.5 :	2,840 cfs
9.	Total project discharge at test flood el. 1606.7 :	2,930 cfs

c. Elevation (Feet, assumed datum)
Elevation 1601 assumed datum is between elevations 1536 and 1541 feet NGVD.

1.	Streambed at toe of dam:	1580
2.	Bottom of cutoff:	varies
3.	Maximum tailwater:	N/A
4.	Recreation pool:	1601.0 +
5.	Full flood control pool:	N/A
6.	Spillway crest (Ungated):	1601.0
7.	Design surcharge (original design):	unknown
8.	Top of dam:	1606.5
9.	Test flood surcharge:	1606.7

d. Reservoir

1.	Length of normal pool:	2,800± ft
2.	Length of flood control pool:	N/A
3.	Length of spillway crest pool:	2,800± ft
4.	Length of pool at top of dam:	2,800± ft
5.	Length of test flood pool:	2,800± ft

e. Storage

1.	Normal pool:	600 acre-ft
2.	Flood control pool:	N/A
3.	Spillway crest pool:	600 acre-ft
4.	Top of dam:	1,160 acre-ft
5.	Test flood pool:	1,180 acre-ft

g. Purpose of Dam - Recreation

h. Design and Construction History - The following information is believed to be accurate based upon plans and correspondence available and from conversations with persons familiar with the history of the dam. The dam was designed in 1962 by Haley and Ward Engineers, Boston, Massachusetts, for the State of Vermont Fish and Game Service. A public hearing, as required by the state, was held April 8, 1961, and continued to April 26, 1962, after which a Hearing Order was issued July 12, 1962. Construction was completed in 1965. No unusual construction problems or conditions are known to have been encountered.

i. Normal Operational Procedures - It is reported that the pond level is drawn down up to a maximum of four feet during the winter months by removal of some of the stoplogs. Other than this, no operational procedures exist other than occasional checking.

1.3 PERTINENT DATA

a. Drainage Area - 3.64 square miles of steep, undeveloped terrain which is virtually 100% wooded.

b. Discharge at Dam Site - Discharge is from over the outlet structure and through the 36-inch outlet conduit. Additional discharge is from a remote emergency spillway at higher flows. Elevations are in feet referenced to an assumed datum as shown on the design drawings. Normal pool elevation 1601 feet assumed datum is between elevations 1536 and 1541 feet NGVD.

1.	Outlet Works (conduits):	
	One 36" reinforced concrete pipe at invert elevation 1580.5	200 cfs
2.	Maximum known flood at dam site:	
	June 30, 1973. Magnitude unknown.	N/A
3.	Ungated spillway capacity at top of dam el. 1606.5 :	2,640 cfs
4.	Ungated spillway capacity at test flood el. 1606.7 :	2,810 cfs
5.	Gated spillway capacity at normal pool el. 1601.0 :	N/A
6.	Gated spillway capacity at test flood el. 1606.7 :	N/A
7.	Total spillway capacity at test flood el. 1606.7 :	2,810 cfs

four sides under surcharge conditions. A 12-inch gated pond drain, controlled by a "T" handle at the operating level, enters the box at elevation 1581. The outlet pipe is 36-inch diameter reinforced concrete, installed at a slope of .005, with its upstream invert matching the bottom of the box.

An 80-foot long remote reinforced concrete emergency overflow spillway exists on the north end of the pond. Any flow over the emergency spillway bypasses Kent Brook and flows down a separate natural drainageway and intermittent stream which enters the Ottauquechee River about 3,500 feet upstream of where Kent Brook joins the river.

Elevations are in feet referenced to an assumed datum as shown on the design drawings for the dam. Normal pool elevation 1601 feet assumed datum is between elevations 1536 and 1541 feet NGVD.

No instrumentation exists at this dam.

c. Size Classification - INTERMEDIATE - The dam impounds 1,160 acre-ft of water with the pond level at the top of the dam, which at elevation 1606.5 is 26.5 feet above the original streambed. According to the Recommended Guidelines, the dam is classified as intermediate in size since its impoundment is between 1,000 acre-ft and 50,000 acre-ft.

d. Hazard Classification - SIGNIFICANT - If the dam were to be breached there is potential for considerable damage and possible loss of a few lives. There would be a sudden 19 foot increase in stage at a light duty road crossing about 3,000 feet downstream of the dam, which would inundate the crossing by 15 feet and destroy it. Further downstream, about 3,750 feet downstream of the dam, is a residential structure about 10 feet above the brook. The rapid increase in stage would flood this structure to a depth of nearly 13 feet. About 5,500 feet downstream of the dam and 1,000 feet downstream of the confluence of Kent Brook and the Ottauquechee River is a triple 7-foot diameter culvert which carries an unimproved roadway over the river. The road, about 9 feet above the streambed, would be overtopped nearly 17 feet by the breach flow. Further downstream on the Ottauquechee, about 12,500 feet from the dam, is a concrete bridge which carries a paved town road over the river. This road, about 14 feet above the streambed, would be overtopped by about 3.5 feet by the failure flood. About 300 feet downstream of this bridge is a mobile home with the floor about 6 feet above the streambed. The mobile home would be flooded to a depth of about 11 feet by the failure flow.

e. Ownership - Department of Fish and Game
Agency of Environmental Conservation
State of Vermont
Montpelier, Vermont 05602
(802) 828-3371

The dam was built by its present owner.

f. Operator - Department of Fish and Game
Agency of Environmental Conservation
State of Vermont
Montpelier, Vermont 05602
(802) 828-3371

PHASE I INSPECTION REPORT

KENT POND DAM

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. James W. Sewall Company has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to James W. Sewall Company under a letter of April 2, 1980 from William E. Hodgson Jr., Colonel, Corps of Engineers. Contract No. DACW 33-80-C-0051 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

3. To update, verify and complete the National Inventory of Dams.

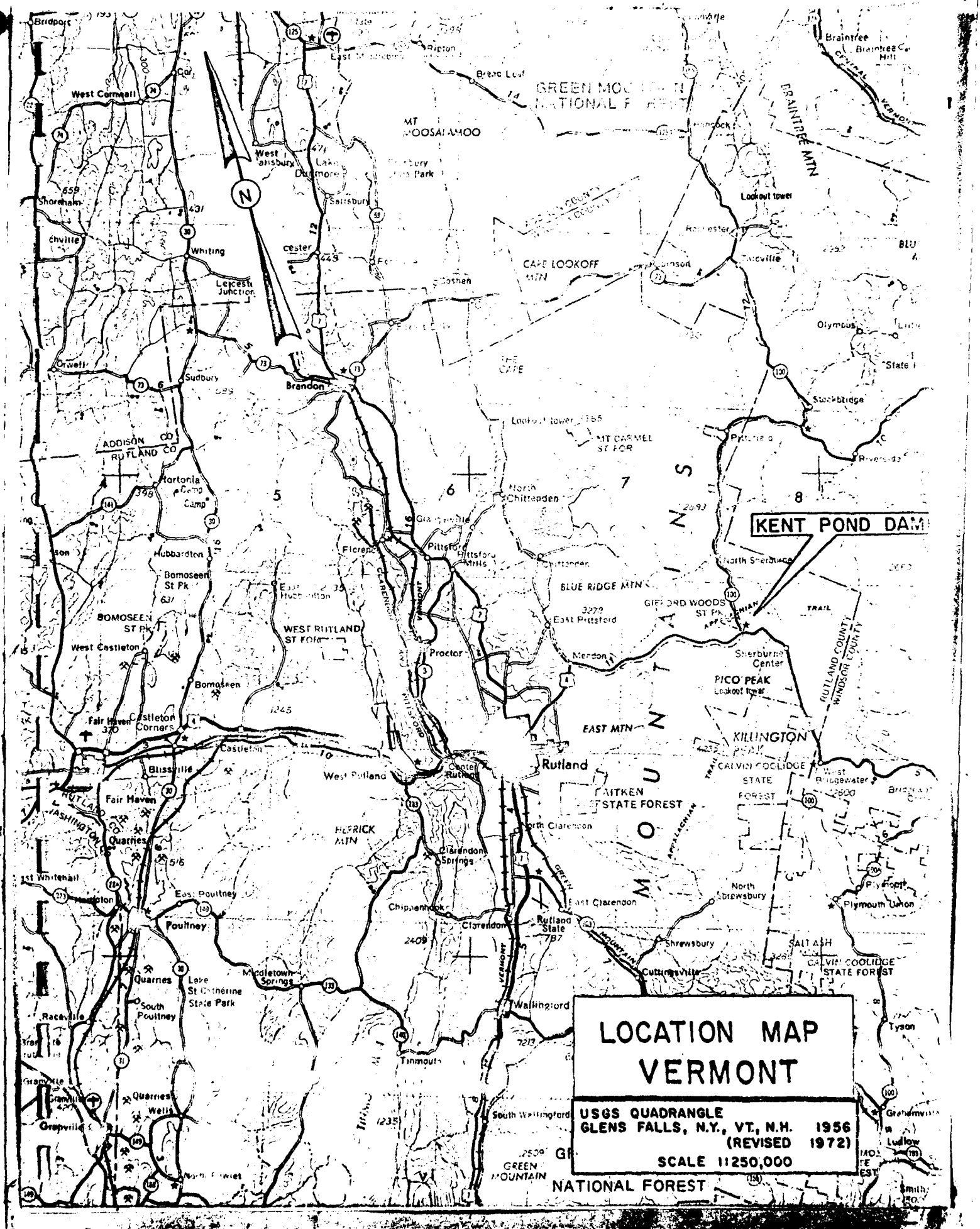
1.2 DESCRIPTION OF PROJECT

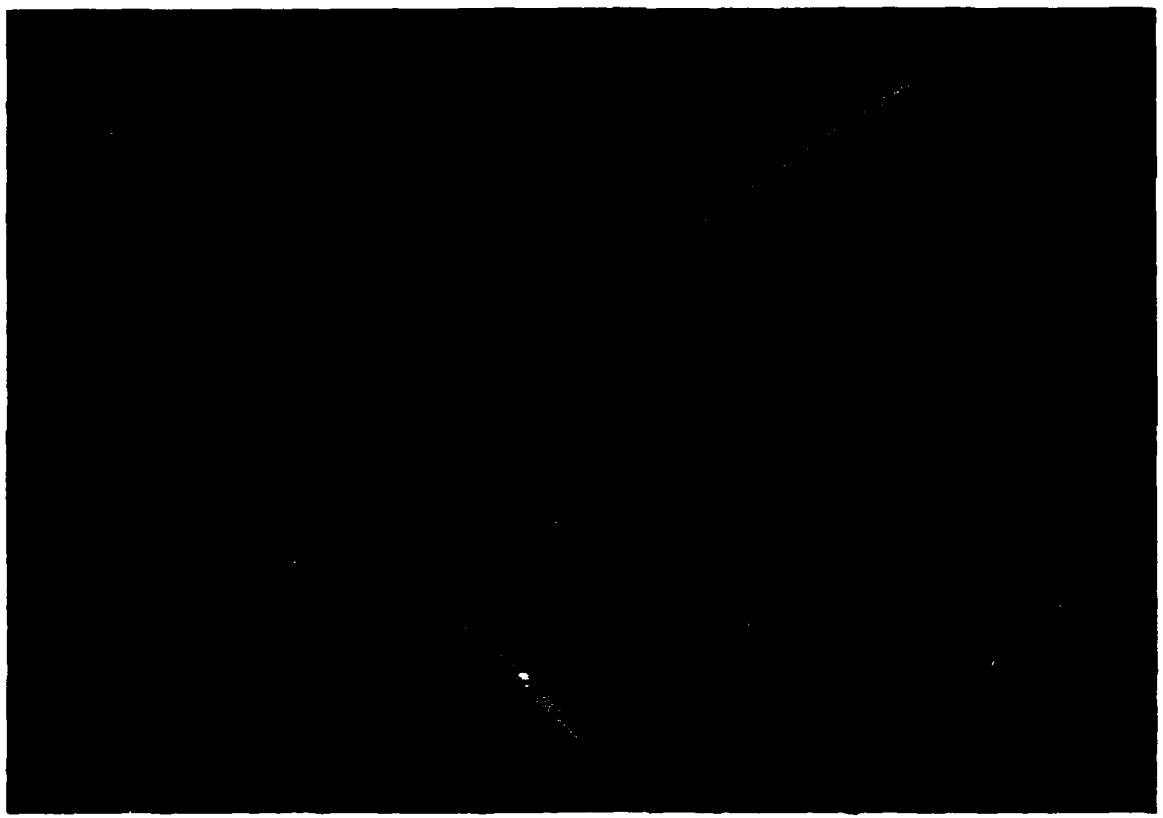
a. Location - The dam is located at the outlet of Kent Pond in the Town of Sherburne, County of Rutland, State of Vermont. The dam is shown on the Pico Peak, Vt. 7.5 minute USGS Quadrangle Map having coordinates latitude N43° 40.5' and longitude W72° 48.1'.

b. Description of Dam and Appurtenances - The dam, completed in 1965, consists of a homogeneous earthfill embankment having a total length of approximately 1450 feet, including outlet works near the left end of the dam.

The embankment has a top elevation of approximately 1606.5, is 26.5 feet in height above the streambed and is 20 feet wide at the crest. The upstream slope is inclined at 3 horizontal to 1 vertical. The downstream slope is also inclined at 3 horizontal to 1 vertical and has no drainage blanket or toe drain.

The outlet structure consists of a reinforced concrete box 10 feet by 10 feet in plan with the bottom at elevation 1580.50 and the top at elevation 1603.0. Pond level control is achieved by two sets of 3-foot long stoplogs in the upstream end of the box. The four stoplog guides extend down six feet below the top of the structure to elevation 1597.0. For a normal pool elevation, stoplogs are inserted up to elevation 1601.0. A 5-foot long by 1.5' deep slot (down to elevation 1601.50) exists in each side of the structure, and the top of the box is open which allows for overflow into the box from all


KENT POND DAM
LOCATION MAP
VERMONT
USGS QUADRANGLE
GLENS FALLS, N.Y., VT., N.H. 1956
(REVISED 1972)
SCALE 1:250,000
Rutland
Brandon
Poultney
Fair Haven
Castleton
West Rutland
Proctor
Pittsford
Wallingford
Tinmouth
Clarendon
Shrewsbury
Killington
Pico Peak
Sherburne Center
Mendon
East Mtn
Blue Ridge Mtn
Cape Lookoff Mtn
Herrick Mtn
Braintree Mtn
Mt Moosalamoo
Mt Carmel
Bomoseen St Pk
Bomoseen
West Castleton
Hubbardton
Orwell
Sudbury
Whiting
Shoreham
Salisbury
Lake Dunmore
Leicester Junction
Middletown Springs
Lake St Catherine State Park
Quarries
Wells
Granville
Hortonia
Camp
Addison Co
Rutland Co
Rutland County
Windsor County
Green Mountain National Forest
Calvin Coolidge State Forest
Gifford Woods St Pk
Plymouth Union
Ludlow
Tyson
Cuttingsville
Chipman Hill
Clarendon Springs
Rutland State
Lookout tower
Braintree
Olympus
Stockbridge
Pittsfield
Rochester
Hancock
Granville
Brandon
Middletown Springs
Tinmouth
Wallingford
Poultney
Fair Haven
Castleton
Rutland
Proctor
Pittsford
Killington
Pico Peak
Sherburne Center
Mendon
Shrewsbury
Clarendon
Chipman Hill
Cuttingsville
Tyson
Ludlow
Plymouth Union
Calvin Coolidge State Forest
Green Mountain National Forest
Appalachian Trail
Long Trail
Vermont
Green Mountains



OVERVIEW PHOTO

U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS JAMES W. SEWALL COMPANY CONSULTANTS OLD TOWN, MAINE	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	KENT POND DAM - VT 00071 SHERBURNE, VERMONT APRIL 22, 1980

SECTION 5: EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The tributary watershed consists of 3.64 square miles of undeveloped steep terrain, virtually 100% wooded and containing no significant storage other than Kent and Pico Ponds. These ponds have a surface area of 110 acres constituting less than 5% of the total drainage area. Kent Pond Dam is an earth embankment equipped with a 6-foot long overflow service spillway and an 80-foot long emergency spillway crest 1 foot higher. The service spillway discharges to Kent Brook, which enters the Ottauquechee River about 4,500 feet downstream of the dam. The emergency spillway discharges to an adjacent un-named brook which also enters the Ottauquechee River. Total spillway discharge capacity is about 97% of the routed Test Flood outflow.

5.2 DESIGN DATA

No design data are known to exist for this project.

5.3 EXPERIENCE DATA

The maximum known flood at the dam site reportedly occurred June 30, 1973. No specific information concerning maximum discharge was located. This flood damaged the earthen channel and concrete weir wall of the overflow spillway, which was subsequently replaced with reinforced concrete. The dam was not overtopped.

5.4 TEST FLOOD ANALYSIS

The Test Flood for this significant hazard, intermediate size dam ranges from one-half of the Probable Maximum Flood (PMF) to the Probable Maximum Flood. One-half of the PMF was selected as the Test Flood since Kent Pond Dam is at the lower end of the intermediate size classification and poses a relatively low risk to the populated areas.

Peak inflow to Kent Pond is 4,241 cfs and was determined using the "Mountainous" guide curve of the "Preliminary Guidance for Estimating Maximum Probable Discharge", dated March, 1978 which provides a cubic foot per second per square mile (CSM) for the PMF, which when applied to the watershed area, provides an estimated PMF in cubic feet per second. Peak outflow is 2,930 cfs with the water elevation 0.2 feet above the top of dam and the initial reservoir level assumed at the crest of the spillway (el. 1601.0 assumed datum). Based upon hydraulics computations, the maximum spillway and outlet capacity is 2,840 cfs, or approximately 97% of the routed Test Flood outflow.

5.5 DAM FAILURE ANALYSIS

Utilizing the April, 1978, "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", the peak failure outflow to Kent Brook with the pool initially at the top of the dam (el. 1606.5 assumed datum) would be approximately 110,100 cfs. Pre-failure flow, assumed to be the spillway discharge with the water level at the top of the dam, was 198 cfs. The hazard area includes the 4,500 foot length of Kent Brook downstream of the dam, and a 9,000 foot reach of the Ottauquechee River downstream from the mouth of Kent Brook. Routing of the failure flood resulted in an approximate 90% flow reduction in the above 13,500 ft. length, and the considerable flood plain storage available on the Ottauquechee below this point indicates little further hazard potential.

The failure flood would produce a sudden increase in stage of 16 feet immediately downstream of the dam, which would overtop a light duty roadway bridge about 3,000 feet downstream by about 14 feet, destroying the bridge and causing considerable roadway damage. Further downstream, about 3,750 feet from the dam, a residential structure with sill elevation about 10 feet above the stream bottom would be flooded to a depth of nearly 13 feet by the rapid increase in stage from 1.2 feet to 22.8 feet. About 5,500 feet from the dam and 1,000 feet downstream of the confluence of Kent Brook with the Ottauquechee River is a triple 7-foot diameter culvert which carries an unimproved roadway over the river. The road, about 9 feet above the streambed, would be overtopped nearly 17 feet by the breach flow. Further downstream on the Ottauquechee, about 12,500 feet from the dam, is a concrete bridge which carries a paved town road over the river. This road, about 14 feet above the streambed, would be overtopped by about 3.5 feet by the failure flood. About 300 feet downstream of this bridge is a mobile home with the floor about 6 feet above the streambed. The mobile home would be flooded to a depth of about 11 feet by the failure flow. There is potential for considerable property damage and loss of a few lives, thus Kent Pond Dam has been classified as a "Significant Hazard" dam.

SECTION 6: EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATION

The visual inspection did not disclose any immediate stability problems. However, the roots of the trees and bushes growing on the upstream slope and near the downstream toe of the dam could lead to internal erosion of the dam if continued growth of the trees is permitted. The trees overhanging the outlet channel and the debris at the downstream end of the spillway channel could restrict the flow of water discharged into the channels.

It was not possible to determine if the wet areas observed downstream of the dam were mainly the result of the rain which fell at the site about 12 hours prior to the inspection or the result of seepage beneath the dam. The dam should be inspected by qualified engineers during dry weather in order to determine the presence of seepage conditions that could affect the stability of the dam.

6.2 DESIGN AND CONSTRUCTION DATA

Due to the lack of in-depth and construction data for this dam, the assessment of safety is based on the results of the visual inspection and on engineering judgment.

6.3 POST-CONSTRUCTION CHANGES

When the dam was constructed in 1965 at the southeast end of Kent Pond, the separate emergency spillway was constructed in a saddle of land at the north end of the reservoir consisting of an 80-foot long concrete weir wall with stone paving on either side, together with an earthen downstream channel.

This emergency spillway received heavy damage during the passage of hurricane "Belle" in July, 1973. During the fall of 1973 the emergency spillway was reconstructed with a concrete slab 25 feet upstream of and 75 feet downstream of the weir wall, with concrete training walls forming the sides of the spillway. The discharge channel is covered with riprap.

6.4 SEISMIC STABILITY

The dam is located in Seismic Zone 2, and in accordance with the recommended Phase I guidelines does not warrant seismic investigation.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition - Based upon the visual inspection, the dam is judged to be in fair condition.

b. Adequacy of Information - Due to the lack of design and construction data for this dam, the assessment of safety is based solely on the visual inspection.

c. Urgency - The remedial measures and recommendations presented below should be implemented by the owner within one year after receipt of this Phase I Inspection Report.

7.2 RECOMMENDATIONS

The owner should engage a qualified registered engineer to undertake further investigations as follows:

a. Inspect the dam during dry weather in order to determine if the wet areas observed downstream are due to seepage conditions that could affect the stability of the dam.

b. Investigate the seepage at the left side of the outlet headwall and determine corrective measures.

The owner should implement all recommendations by the engineer.

7.3 REMEDIAL MEASURES

Operating and Maintenance Procedures

1. The trees on the upstream slope and within 20 feet of the downstream toe should be cut and later new growth cut every two years.

2. After the brush is removed, the trees overhanging the outlet channel should be cut and later new growth cut every two years.

3. The debris along the upstream slope of the dam, at the outlet structure and at the downstream end of the spillway channel should be removed periodically.

4. The grass embankment slopes should be mowed on a regular basis, at least once a year.

5. A safer and more secure means of access to the pond drain valve handle of the outlet control structure should be provided.

6. The dam should be monitored during periods of intense rainfall and a formal downstream warning system, to be implemented in the event of flood flow or imminent dam failure conditions, should be developed by the owner.

7. A formal program of operating and maintenance procedures should be instituted and fully documented to provide accurate records for future reference.

8. A formal annual inspection of the dam and emergency overflow by qualified engineers should be provided. The emergency overflow should be inspected after each major storm event.

7.4 ALTERNATIVES

This study has identified no practical alternative to the above recommendations.

APPENDIX A

VISUAL CHECK LIST WITH COMMENTS

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Kent Pond Dam

DATE [illegible]

TIME 1100

WEATHER Heavy rain

W.S. ELEV. _____ U.S. _____ DN.S.

PARTY:

1. Steven D. Mr[illegible] S.D.M.
2. [illegible] R.L.H.
3. Charles A. [illegible] C.A.S.
4. David P. LaSorda D.P.L.
5. Steven L. [illegible] S.L.S.
6. [illegible]
7. _____
8. _____
9. _____
10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Dam Embankment	D.P.L. S.L.S. C.A.S. R.L.H. S.D.M.	
2. Control Structure	S.D.M. R.L.H. C.A.S.	
3. Outlet Pipe	D.P.L. S.L.S. C.A.S. S.D.M.	
4. Dyke - Pond Emergency Spillway	D.P.L. S.L.S. S.D.M. R.L.H. C.A.S.	
5. Approach Channel	D.P.L. S.L.S. S.D.M. R.L.H. C.A.S.	
6.		
7.		
8.		
9.		
10.		

PROJECT Hart Dam DATE Aug. 6, 1980

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE Geotechnical Engineers Inc. NAME Geotechnical Engineers Inc. D.P.L. S.L.H.

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	Minor cracks in pavement on crest.
Pavement Condition	Good
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	No misalignment observed
Horizontal Alignment	No misalignment observed
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	No evidence of trespassing
Sloughing or Erosion of Slopes or Abutments	None observed
Rock Slope Protection - Riprap Failures	No failures observed
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	Three wet areas downstream of downstream toe of dam.
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Some small bushes on downstream slope.

PERIODIC INSPECTION CHECKLIST

PROJECT Kent Bend Dam DATE [illegible] 20

PROJECT FEATURE _____ NAME _____

DISCIPLINE [illegible] Geotechnical Engineers Inc. NAME [illegible]

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	[illegible]
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or Near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	
Vegetation	

PERIODIC INSPECTION CHECKLIST

PROJECT Red Rock Dam DATE [illegible]

PROJECT FEATURE _____ NAME _____

DISCIPLINE [illegible] Soils Eng. NAME [illegible]
Geotechnical Engineers Inc.

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Not observed — under water
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	Not observed — under water
Condition of Concrete	
Stop Logs and Slots	

5

PROJECT [illegible] DATE [illegible]

PROJECT FEATURE [illegible] NAME [illegible]

DISCIPLINE [illegible] NAME [illegible]

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Control structure is a reinforced [illegible] 2nd st. [illegible]. It leads to the 36" outlet pipe at the dam
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Good
Spalling	None observed
Visible Reinforcing	None observed
Rusting or Staining of Concrete	Minor staining
Any Seepage or Efflorescence	None observed
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	None observed
Rusting or Corrosion of Steel	None observed
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PROJECT _____ DATE _____

PROJECT FEATURE Outlet Pipe NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	36" Diameter pipe from the [illegible] structure, concrete [illegible] at downstream end. Good
Rust or Staining on Concrete	Minor staining at [illegible]
Spalling	[illegible]
Erosion or Cavitation	[illegible]
Cracking	None visible
Alignment of Monoliths	
Alignment of Joints	Left side
Numbering of Monoliths	
	A small seepage area was visible at the left end of the headwall.

PERIODIC INSPECTION CHECK

PROJECT [illegible] Dam DATE [illegible]

PROJECT FEATURE Outlet Works NAME [illegible]

DISCIPLINE [illegible] Engineer NAME [illegible]

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	None observed
Channel	Good to fair
Loose Rock or Trees Overhanging Channel	Some trees overhanging channel
Condition of Discharge Channel	Good to 35' downstream of outlet works. Fair downstream from this point

PERIODIC INSPECTION CHECKLIST

PROJECT _____ DATE _____

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	
Floor of Approach Channel	Riprap and soil lining
b. Weir and Training Walls	
General Condition of Concrete	Good
Rust or Staining	Minor staining
Spalling	None observed
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Drain Holes	None observed
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	Some trees at downstream end of channel
Floor of Channel	
Other Obstructions	Fallen trees and debris at downstream end of channel. There has been some displacement and settlement of some rocks at end of chan

On the morning of September 10, 1973, John Scott of DuBois & King, Inc., met with Messrs. Rouleau, Manning and Spies of the Vermont Department of Water Resources to present a basis for final design. A verbal approval was given to proceed.

On September 12, 1973, DuBois & King, Inc. personnel discussed the basis of design further with Messrs. Manning and Rouleau of the Water Resources Department regarding the selection of the concrete alternative versus using riprap.

On September 17, 1973, written approval of the basis of design dated September 13th, 1973, was received by DuBois & King, Inc.

Preparation of final plans and specifications commenced on September 10th, 1973 and discussions between members of the Water Resources Department and DuBois & King, Inc. took place during the development of the final planning documents.

On the 21st of September, 1973, Messrs. Spies and Manning visited DuBois & King offices to review the status of the plans, to go over the details and to briefly review the specifications. No changes were indicated at that meeting and DuBois and King proceeded to finalize all plans and specifications ready for bidding on September 24th, 1973.

The preliminary notice to possible interested contractors was sent out on September 20th, 1973. This list was sent to 40 contractors. The project will be formally advertised in the Burlington Free Press and the Rutland Herald on September 24th, 1973 and October 1st, 1973.

Bids will be received at the DuBois & King offices at 2:00 p.m., daylight saving time on October 8, 1973. It is the intent to award the contract and authorization to proceed by October 12, 1973 and substantially complete concrete and riprap work in 65 days. Final grading, seeding, cleanup would be accomplished in the Spring and the entire job closed out by June 1, 1974.

Attached to this memorandum is a brief summary of the technical basis of design. Also attached is an engineer's estimate of the work as indicated in the proposal section of the contract document.

RED/jpb

Attachment

September 24, 1973

2. The uncertainties of obtaining suitable riprap, possible reluctance of contractors to bid, satisfactory riprap reconstruction and the necessity to shape a spillway to certain dimensions using heavy riprap were all discussed.

3. The second alternative was to use a concrete shute with limited riprap protection at the upstream end and at the exit appeared to be more desirable because of the assurance that the work would be performed satisfactorily and could be controlled. The channel could be shaped and concrete work might be installed faster and more satisfactorily in the short period of time remaining to construct the work prior to winter season.

The outcome of this meeting was that DuBois & King, Inc. was to finalize the quantities, prepare a project cost estimate and submit a report immediately summarizing the use of the concrete alternate.

It should be pointed out that at this point in time, the design work was to be confined to property owned by the Fish and Game Department and although work downstream in the channel, while desirable, was of questionable status because the property owner had not been contacted at that time. Therefore, the preliminary report submitted and dicussed below did not contemplate substantial work beyond the concrete shute.

On July 26, 1973, a formal written preliminary report on the reconstruction of the spillway was submitted to Commissioner Kehoe. The construction costs were estimated (at that time) to be between $86,000 and $104,000 and the project cost was estimated to range between $103,000 and $122,000. The preliminary report indicated that if DuBois & King, Inc. were authorized to proceed with the final design by August 1, 1973 that the plans and specifications would be ready sometime during the week of August 15, 1973, thereby permitting early bidding and construction to be underway in early September and hopefully completed early in November, 1973.

On July 31, 1973, an inspection report on the entire Kent Pond Dam was submitted to Commissioner Kehoe. This report contained descriptions and photographs of damage that occurred at the emergency spillway and erosion at the outlet conduit through the main dam. It was recommended that riprap be placed at the outlet to arrest further erosion and restore the channel at this point to a satisfactory condition.

There was no activity on the project until about August 22, 1973 when Mr. LaRosa contacted Mr. DuBois to prepare formal contracts for the final design and other associated engineering services. These contracts were prepared and hand delivered to Mr. Brierley of the Vermont Department of Water Resources on August 24, 1973.

The contract between the Vermont Fish and Game Department and DuBois & King, Inc. is dated August 30th, 1973. These contracts were transmitted to DuBois & King on August 30th, 1973 and received on September 4th, 1973. Mr. Collins who transmitted the contracts indicated there would be a verbal approval to proceed within a few days. Mr. Collins called the DuBois & King office and gave a verbal approval to proceed on September 4th, 1973.

KENT POND EMERGENCY SPILLWAY
VERMONT DEPARTMENT OF FISH AND GAME
SUMMARY OF EVENTS AND CONCLUSIONS LEADING TO BASIS OF DESIGN

Background

On July 9, 1973, Ed Kehoe, Commissioner of the Vermont Fish and Game Department telephoned Mr. William Baumann, Vice President of DuBois & King, Inc., and indicated that he wanted DuBois & King, Inc. to do the preliminary and final design work for the repairs to the Kent Pond Dam Emergency Spillway in Sherburne, Vermont. This spillway was severely eroded during the July, 1973 flood.

On July 11, 1973, at 9:30 a.m., Richard E. DuBois, President of DuBois & King, Inc., met with Mr. Robert Collins, Maintenance Supervisor of the Vermont Fish and Game Department at the site of the emergency spillway. A general inspection of conditions took place together with discussions regarding property lines, rights of access and possible methods of repair.

On July 12, 1973, Mr. DuBois contacted Andy Rouleau of the Water Resources Department to discuss the project and Mr. Rouleau advised that some data was available in their files. Also, Mr. Rouleau requested an inspection of the entire dam to determine if other damage had occurred. DuBois & King, Inc. agreed to perform this inspection.

On July 12, 1973, Mr. DuBois wrote Commissioner Kehoe confirming his conversation with Mr. Baumann relative to performing the engineering services and indicating that the preliminary work would be ready for discussion no later than July 25, 1973.

On July 13, 1973, Mr. LaRosa called regarding contractual arrangements for the preliminary design work. Apparently up to $2,000 was authorized for this portion of the work.

On the afternoon of July 23, 1973, Commissioner Kehoe and Mr. Collins of the Fish and Game Department met with Mr. DuBois at the DuBois & King offices to go over the preliminary schemes and cost estimates for the proposed reconstruction. At this meeting, a general discussion of two alternatives took place. It was the general consensus of those present that a concrete shute or concrete spillway would be more desirable than a riprap spillway. The reasons for this were:

1. Preliminary studies utilizing survey data obtained at the site indicated that the riprap would have to be placed on the sides of the spillway at a slope of 1 to 1 or greater because of topographic limitations. Serious concern was expressed by Mr. DuBois concerning the placing of the riprap and possible erosion and slippage because of the steep side banks, if this alternative were used.

DuBOIS & KING, INC.
Engineering and Environmental Services
RANDOLPH, VERMONT 05060

Phone (802) 728-3376 & 3377

LETTER OF TRANSMITTAL

DATE	JOB NO
September 25, 1973	73114

ATTENTION: Andy Rouleau

RE: Kent Pond
Sherburne, Vermont

TO: Vermont Department of Water Resources
State Office Building
Montpelier, Vermont 05602

GENTLEMEN:

WE ARE SENDING YOU [X] Attached [ ] Under separate cover via _____ the following items:

[ ] Shop drawings [ ] Prints [ ] Plans [ ] Samples [ ] Specifications

[ ] Copy of letter [ ] Change order XX Copies

COPIES	DATE	NO.	DESCRIPTION
1	Copy to Norman		Summary of Events and Conclusions Leading to Basis of Design
1	Oct 1 '73		Engineer's Estimate
	Copy to Bill Oct 2 '73		

Advise Norman Kent of this

ROUTING
GENERAL
TO NOTED DATE
AJR ~ 9/27
DON 9/28
D.S.
SUSPENSE

THESE ARE TRANSMITTED as checked below: If Money available?

[ ] For approval [ ] Approved as submitted [ ] Resubmit ____ copies for approval
[X] For your use [ ] Approved as noted [ ] Submit ____ copies for distribution
[ ] As requested [ ] Returned for corrections [ ] Return ____ corrected prints
[ ] For review and comment [ ] _____
[ ] FOR BIDS DUE _____ 19____ [ ] PRINTS RETURNED AFTER LOAN TO US

REMARKS The basis of design was sent to you under separate cover.

Bid opening Oct 8 2PM
Note: Columbus Day!

COPY TO _____

Richard E. DuBois, P.E. President

SIGNED: Richard E. DuBois

If enclosures are not as noted, kindly notify us at once

ROUTING		
GENERAL		
TO	NOTED	DATE
ar	~	7/25
do	Dfs	7-25-75
~~DM~~	wjm	7/25/75
SUSPEND TO		
FILE		

FILE COPY

MANAGEMENT & ENGINEERING DIVISION

July 25, 1975

MEMORANDUM

To: Edward F. Kehoe, Commissioner, Department of Fish and Game

From: Donald H. Spies, Engineer, Department of Water Resources

Re: Kent Pond Dam - Sherburne

I made an inspection of the subject structure on July 16, 1975. There is some tree growth on the upstream face which should be cut down. No cracking or erosion was found on the earth fill, however, along the downstream toe north of the spillway, an animal has been grubbing in the grass and has torn up sections of the sod. These areas should be regraded and reseeded. No leakage or seepage was found along the earth fill.

The principal spillway appears to be in good shape and the streambed at the outlet seems to be stable. The emergency spillway is also in good shape. The trench drain looks good and was working at the time of the inspection. A hair-line temperature crack was noted in the spillway's east wall; this is not a serious problem at the present, but should be monitored.

This dam is in good condition.

DHS/law
cc: William Sladyk

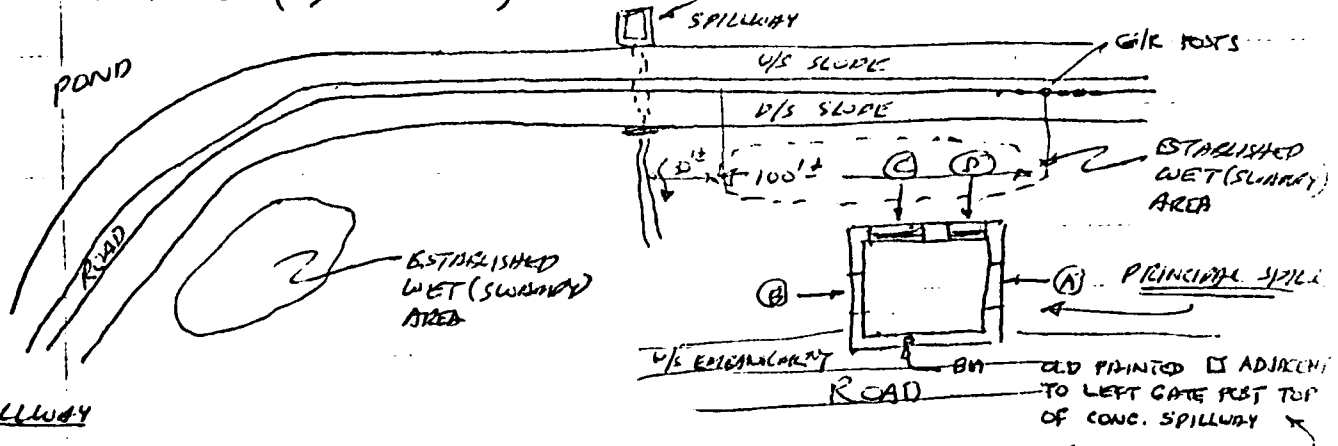
9-19-78

To: File

Fm: AJB

Re: Kent Pond Dam – Sherburne

On 9-18-78 the writer made a brief inspection of the Kent Pond Dam. The dam is in good condition with ~~some~~ some maintenance (grass cutting and debris removal) needed.



SPILLWAY

TRASH RACKS Ⓐ & Ⓑ AT SPILLWAY SECTIONS
– SMALL LOGS CAUGHT ON RACKS

STOP LOG COLUMN Ⓒ – SOME DEBRIS (SAND) – FULL COLUMN EL ≅ TOP OF CONC SILLS AT Ⓐ & Ⓑ

STOP LOG COLUMN Ⓓ – CLEAR — 1 BOARD ABOVE COLUMN Ⓒ — NO FLOW

WL = –1.31' @ BM @ DAM
= –4.20' @ BM @ FOG ACCESS

EMBANKMENT

(1) U/S SMALL AMT. SMALL BRUSH — SHOULD BE CUT & GRASS SHOULD BE CUT

(2) D/S CLEAR OF BRUSH — NEEDS MOWING

– SLOPE IS DRY EXCEPT SMALL AREA 3–4' ABOVE TOE ABOUT 60' LEFT OF OUTLET CHANNEL WHICH IS WET

– TWO ESTABLISHED (LATTICES) SWAMPY AREAS AS NOTED ABOVE)

OUTLET

(1) CHANNEL & 36"ϕ RCP CLEAR – DEPTH OF FLOW = +0.9' ORT INVERT

FILE COPY

ROUTING		
TO	INITIAL	DATE
CEPB	CAM	9/26/78
SUSPENSE TO		
FILE		

WATER QUALITY DIVISION

September 26, 1978

MEMORANDUM

To: Ed Kehoe, Commissioner of Fish & Game

From: A. Peter Barranco, Jr., Environmental Engineer

Subject: Kent Pond Dam - Sherburne

On September 18, while in the area, I made a brief inspection of the subject structure and found the dam to be in generally good condition.

The embankment was dry along the downstream slope except for a small wet area about 4' above the toe some 60' left of the outlet channel. This does not appear to be a problem but should be monitored periodically. There are two established (cattails, etc.) swampy areas downstream of the toe - one about 100' long to the left of the outlet channel and the other to the right of the outlet channel adjacent to the curve in the embankment. No boils were visible and these may be natural wet areas.

Although there was only a little brush growing on the upstream slope, both slopes should be mowed at least once a year to prevent future growth and th facilitate inspection for seepage, animal burrows, etc.

Some debris (logs and branches) were caught in the trash racks on the spillway (stop log structure) and should be removed.

vl

VERMONT DEPARTMENT OF WATER RESOURCES

INFORMATION SHEET

Name of Dam Kent Brook Town Shelburne

Owner Dept. of Fish and Game Name of Stream Kent Brook

Address Montpelier Classification

Vermont

U.S.G.S. Coordinates: Lat. 43° 40' - 32" Long. 72° ~~45~~ 48' - 4"

U.S.G.S. Map Mt. Pico Peak Aerial Photos VT-62-H 25-221, 222

U.S.G.S. Elev. @ Spillway

Total Length of Dam 1500' Crest Width of Emergency Spillway 80'

Width of Top 20' Maximum Height 26.5 ft.

Spillway Capacity: Principal Emergency

Pond Area 101.5 acres Drainage Area ~~3.5~~ 3.64 sq miles

Pond Volume: Normal Water Level Design High Water Level

Maximum Water Depth: Normal Water Level 21 ft. Design High Water Level

Storage Before Emergency Spillway is Used

Use of Reservoir Recreation, Fish propagation

Description of Dam: Earth fill w/ 3 on 1 slopes on each face

Description of Spillway(s): Concrete weir w/stone paving

Designed by Haley & Ward Eng, Boston Year Built 1965

Hearing Date 1) April 8, 1961 2) June 14, 1962 Order Date July 12, 1962

Additional Remarks:

Plans in PF #6 "dams"

B-4

KENT POND DAM

SUMMARY OF DATA AND CORRESPONDENCE

KENT POND DAM

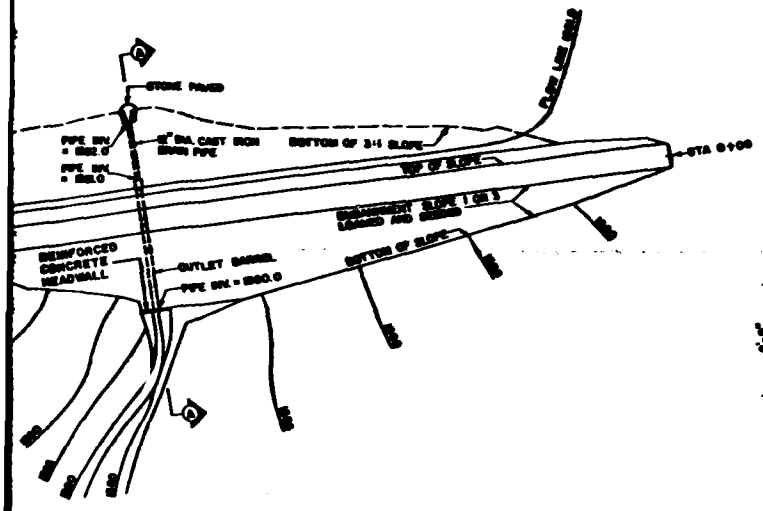
EXISTING PLANS

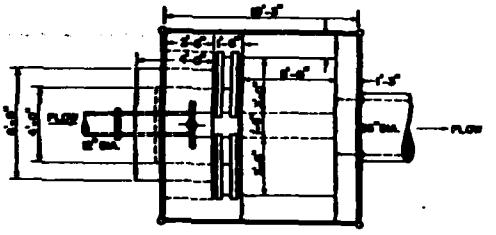
On file with the Vermont Department of Water Resources:

1. State of Vermont Fish and Game Service
   Sherburne
   Kent Brook Dam
   Haley and Ward Engineers, Boston, Mass.
   Dwg. 2 of 10 - General Plan of Proposed Dam, March 14, 1962
   Dwg. 6 of 10 - Plan of Spillway and Sections of Embankment, May, 1962
   Dwg. 7 of 10 - Control Structure, March 14, 1962

2. Vermont Department of Fish and Game
   Kent Pond Emergency Spillway
   DuBois and King, Randolph, Vermont
   Sheet 2 of 5 - Structural Plans and Details, September, 1973

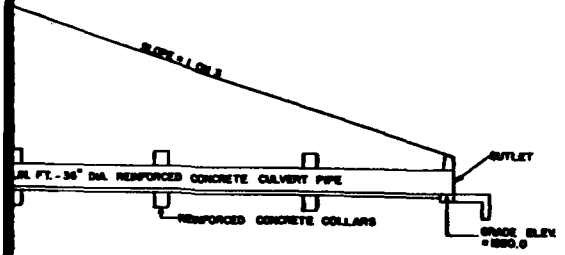
2

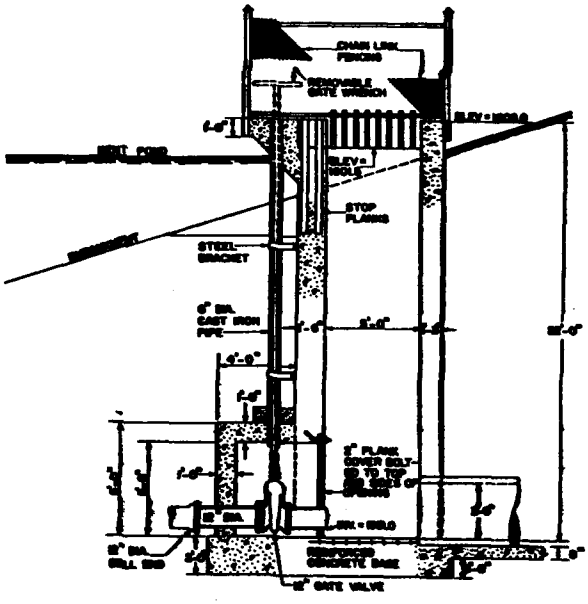




PLAN OF OUTLET CONTROL STRUCTURE

0 0 FEET 4 8





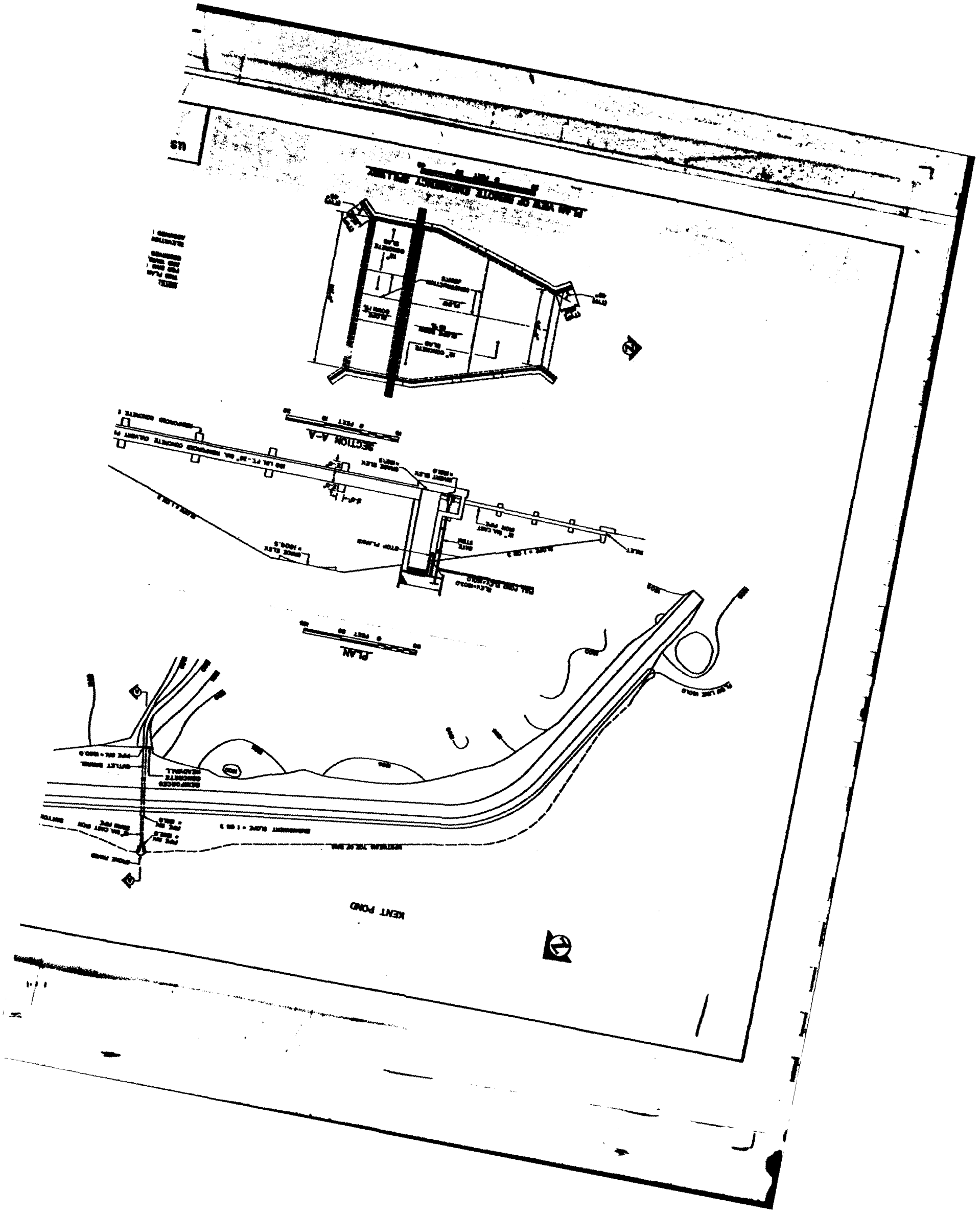
NOTE:
THIS PLAN COMPILED FROM ORIGINAL PLANS FOR DAM CONSTRUCTION IN 1902 BY HALEY AND WARD, ENGINEERS, AND MODIFIED AS OBSERVED IN THE FIELD.

ELEVATIONS REFERENCED TO AN ASSUMED DATUM

ELEVATION OF OUTLET CONTROL STRUCTURE

0 0 FEET 4 8

U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	JAMES W. SEWALL CO. CONSULTING ENGINEERS 147 CENTRE ST. OLD TOWN, ME. TEL. 207-827-4456	NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS MENT POND DAM TB-1 BANGOR, ME.


KENT POND

APPENDIX B

ENGINEERING DATA

PROJECT _____ DATE _____

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	There is no service bridge on this project.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

ENGINEER'S ESTIMATE

KENT POND EMERGENCY SPILLWAY

24 September 1973 — DuBois & King, Inc.

ENR Index = 1930

Item No.	Estimated Quantity	Brief description; unit or lump sum price bid in both words and figures	Total in figures Ø
1		Furnishing concrete poured in place and finished complete with all appurtenant materials and work.	
1a	400 Cu.Yd.	Reinforced Class A concrete, per cubic yard: One hundred fifty dollars and no cents ($ 150.00)	$ 60,000.00
1b	60 Cu.Yd.	Class B concrete fill, per cubic yard: One hundred thirty dollars and no cents ($ 130.00)	$ 7,800.00
2		Furnishing gravel in place, graded and compacted.	
2a	380 Cu.Yd.	Select Gravel, per cubic yard: Seven dollars and no cents ($ 7.00)	$ 2,660.00
2b	700 Cu.Yd.	Bank Run Gravel, per cubic yard: Five dollars and no cents ($ 5.00)	$ 3,500.00
3		Furnishing stone for riprap, emplaced and positioned.	
3a	360 Sq.Yd.	Type A Riprap, per square yard: Forty dollars and no cents ($ 40.00)	$ 14,400.00
3b	140 Sq.Yd.	Type B Riprap, per square yard: Fifteen dollars and no cents ($ 15.00)	$ 2,100.00
3c	50* Sq.Yd.	Type C Riprap, per square yard: Twenty-five dollars and no cents ($ 25.00)	$ 1,250.00
4	950 Cu.Yd.	Earth Excavation and disposal, per cubic yard: Three dollars and no cents ($ 3.00)	$ 2,850.00

Ø For informal comparison only; not to be considered a part of this Proposal.
* Indeterminate; quanity assumed for comparison of bids.

Item No.	Estimated Quantity	Brief description; unit or lump sum price bid in both words and figures	Total in Figures Ø
5	10* Cu.Yd.	Rock Excavation and disposal, per cubic yard: Fifty dollars and no cents ($ 50.00)	$ 500.00
6	1200 Sq.Yd.	Loaming and Seeding, per square yard: One dollars and fifty cents ($1.50)	$ 1,800.00
7	Lump Sum	Handling flows during construction, the lump sum of: Five hundred dollars and no cents ($ 500.00)	$ 500.00
8	Lump Sum	Cleaning up, the lump sum of: One Thousand dollars and No cents ($1,000.00)	$ 1,000.00
		Sub Total	$ 98,360.00
		10% Contingencies	9,640.00
		TOTAL ESTIMATED CONSTRUCTION COSTS	$108,000.00

Ø For informal comparison only; not to be considered a part of this Proposal.
* Indeterminate; quantity assumed for comparison of bids.

BASIS OF DESIGN
EMERGENCY SPILLWAY
KENT POND DAM

LOCATION: Kent Pond Dam
Sherburne, Vermont
See attached map.

OWNER: Vermont Department of Fish and Game

WATERSHED CHARACTERISTICS:

Drainage area - 3.64 square miles

Precipitous Terrain - Elevation 1600 USGS at Pond
- Elevation 3957 USGS Top of Pico Peak

Pondage - Limited amount in Pico Pond
(No data available)
- Some in Kent Pond
(No stage storage data available)

RUNOFF RECORDS:

No data available on discharge through emergency spillway.

Gaging station data available for Kent Brook station located at Route 100 -- data record starts October 1963 and runs to current year.

Peak discharges at gaging station:

- 302 cfs March 23, 1968
- 1973 Flood - ?

Adequacy of Records - Neither considered long enough nor complete enough to utilize with statistical confidence to determine probable peak discharge.

DETERMINATION OF PEAK DESIGN DISCHARGE:

Recognizing there is some pondage in watershed, i.e., Pico Pond and Kent Pond, use attached unit runoff chart and scale down maximum curve slightly.

Note: A hydrograph and flood routing analysis is not being made because:

1. Insufficient data available.

2. Watershed relatively small.

B-14

3. Insufficient funds and time available to develop accurate stage storage curves.

4. A theoretical analysis is only as accurate as the basic raw data.

From attached Unit Runoff Chart:

- 580 cfs per square mile for 3.64 square mile watershed.

Scale down slightly for pondage and use 550 cfs/sq.mi.

Therefore, Peak Design Discharge is estimated to be:

- 550 cfs x 3.64 cfs/sq.mi. = 2000 cfs

GENERAL FEATURES OF EMERGENCY SPILLWAY:

Concrete chute of rectangular cross section extending 25 feet upstream and 75 feet downstream from present weir wall.

Slope of spillway = .133 (10 ft. drop in 75 ft.)

Vertical side walls, nominal 5 feet high.
See attached print.

Hydraulic profile information is tabulated below. Calculations (7 sheets) are attached.

FLOW, Q = 2000 cfs

Location	Depth, Ft.	Velocity, fps.
At weir crest	2.69	9.3
25' downstream of crest	1.30	19.2
50' downstream of crest	1.30	22.3
75' downstream of crest	1.36	25.3

Erosion protection to consist of heavy stone upstream and downstream of structure. Stone in area immediately below structure will be grouted in place. See detail on print.

A stilling basin with ogee-section dam crest was considered as a possible design, but was rejected for the following reasons:

1. It is unlikely that a contractor interested in a job of this size would be experienced in forming complex curves in concrete.

2. The extra work involved would double or triple the cost.

3. The steepness of the drainage course dictates supercritical flow through its entire length.

No man-made structure, therefore, can prevent rapid flow from occurring downstream. The sole benefit of a stilling basin would be to dissipate an insignificant amount of energy.

4. Most dry spillways of Corps of Engineers flood control dams do not have stilling basins.

INSPECTION REPORT

ON

KENT POND DAM

July 24, 1973

INSPECTION REPORT ON KENT POND DAM

General

On the morning of July 11, 1973, Richard E. DuBois, P.E. of DuBois & King, Inc. met with Mr. Robert Collins, Maintenance Supervisor of the Vermont Department of Fish and Game. The meeting consisted of a cursory inspection of the failure of the emergency spillway at the Kent Pond Dam located in Sherburne, Vermont.

On July 24th, 1973, Richard E. DuBois, P.E., again inspected the emergency spillway failure and made a detailed inspection of the entire Kent Pond Dam.

This report indicates the findings of the inspection of July 24th, 1973.

Photographs

A series of photographs taken on July 24th, 1973, are located in the appendix of this report.

Condition of Emergency Spillway

The emergency spillway containing a concrete weir wall approximately 80 feet long was subject to severe erosion and failure as a result of heavy precipitation occurring on June 30th, 1973, and/or July 4th, 1973.

Photograph No. 1 indicates the extent of the erosion on the downstream side of the concrete weir. Approximately 10 feet of fill material or existing ground was eroded away and carried downstream. Erosion occurred to the extent that water actually flowed beneath the concrete footings.

Photograph No. 2 and Photograph No. 3 indicates the extent of erosion in the immediate vicinity of the concrete weir wall.

DuBois & King, Inc. has been retained by the Vermont Department of Fish and Game to prepare preliminary proposals for restoration of this emergency

spillway. These have been prepared and submitted to the Fish and Game Department on July 25th, 1973.

Restoration of the emergency spillway should commence as soon as possible so that work can be completed prior to winter.

Earth Embankment Section of Dam

There appears to be little, if any, damage to the earth embankment section of the dam as a result of the early July floods.

Photographs 4, 5, and 6 indicate the general conditions of the earth embankment and rip rap protection on July 24th, 1973.

The water in the impoundment had been substantially lowered below the plank outlet structure. Water was discharging through the outlet pipe beneath the earth embankment to Kent Brook on the date of inspection.

Erosion Below Outlet

Photographs 7 and 8 indicate the area of erosion at the exit of the outlet tube downstream of the dam. This erosion appears to be a result of heavy discharges through the conduit. A section approximately 40 feet long and 8 to 10 feet in depth appears to be eroded away on the northerly side of Kent Brook. This erosion should be stopped by placing heavy dumped stone or rip rap along the eroded area.

Minor Maintenance Problems

During the inspection, it was noted that some metal work at the outlet structure should be painted with a protective coating. This included the beginnings of major corrosion on the metal sleeve housing the gate valve stem, particularly as indicated in Photo No. 9.

Other items of maintenance might include removal of minor debris and refuse along the shore line of the pond particularly along the face of the dam.

Consideration should be given to any necessity to replace stop plank pins at this time. A close inspection of the condition of the pins was not possible since they were in the locked enclosure.

Minor Seepage Under Dam

On the downstream side, at the toe of the embankment and beyond, it was noted that there are several areas of minor seepage. These seem to be insignificant and do not appear to presently jeopardize the structural integrity of the dam itself. Limited observations were made in respect to this seepage, but it appeared that with the water level in the pond being lower than normal, that such seepage had partially subsided. A typical seepage area is shown in Photo No. 10.

Downstream Damage

During the inspection, approximately 1/2 mile of drainage course was inspected below the emergency spillway. It was noted that several trees were undercut by the onrushing water and severe damage occurred to the adjacent land. Also deposits of sand, gravel, and debris were made outside the normal water course descending into the woodlands.

Recommendations

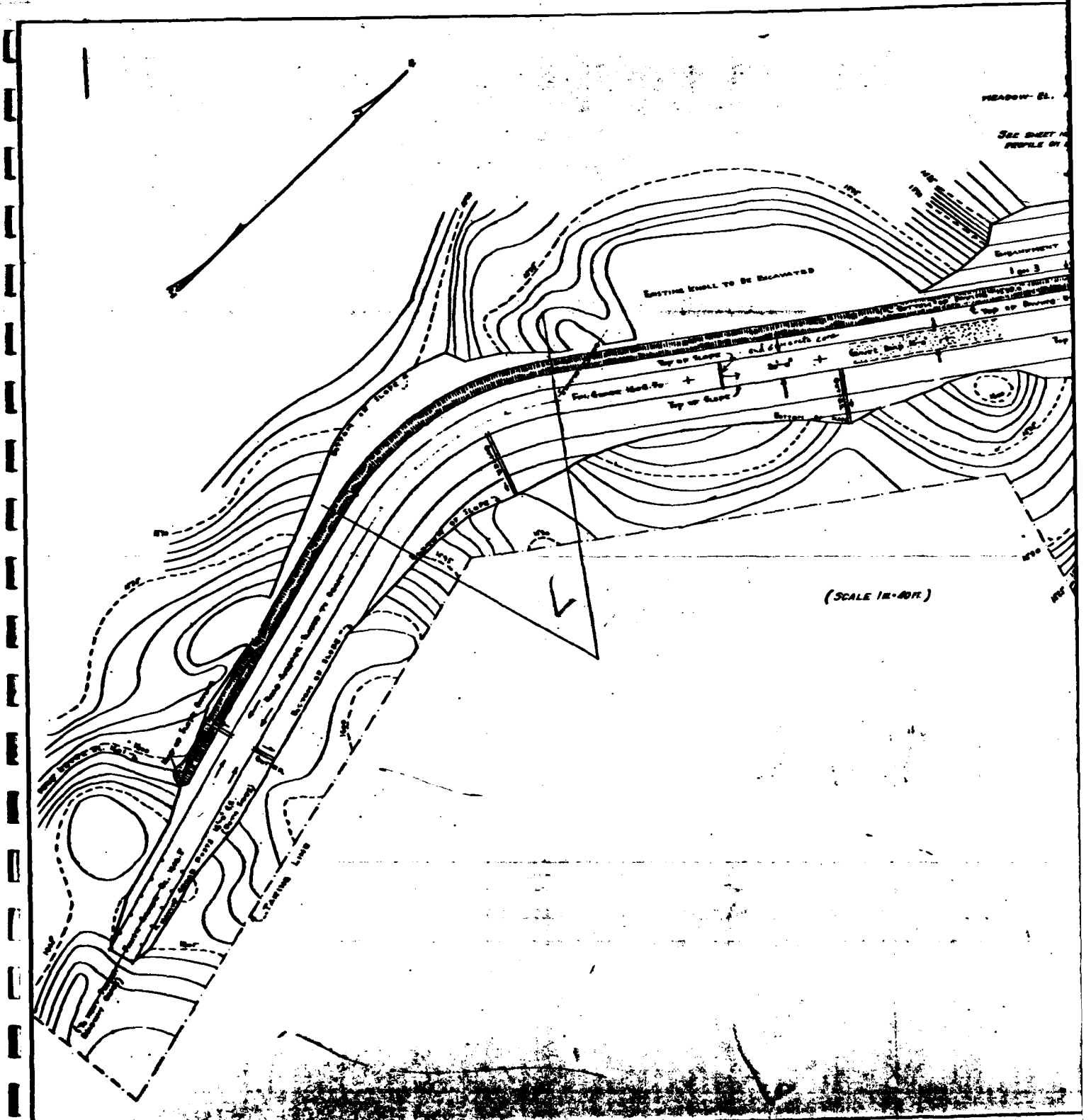
It is recommended that the emergency spillway be restored as soon as possible and hopefully prior to the forthcoming winter season.

It is recommended that the eroded area below the outlet be protected with dumped rip rap.

Minor maintenance items such as debris removal are optional, however, the corrosion on the valve stem sleeve should be steel brushed and painted with a suitable protective coating.

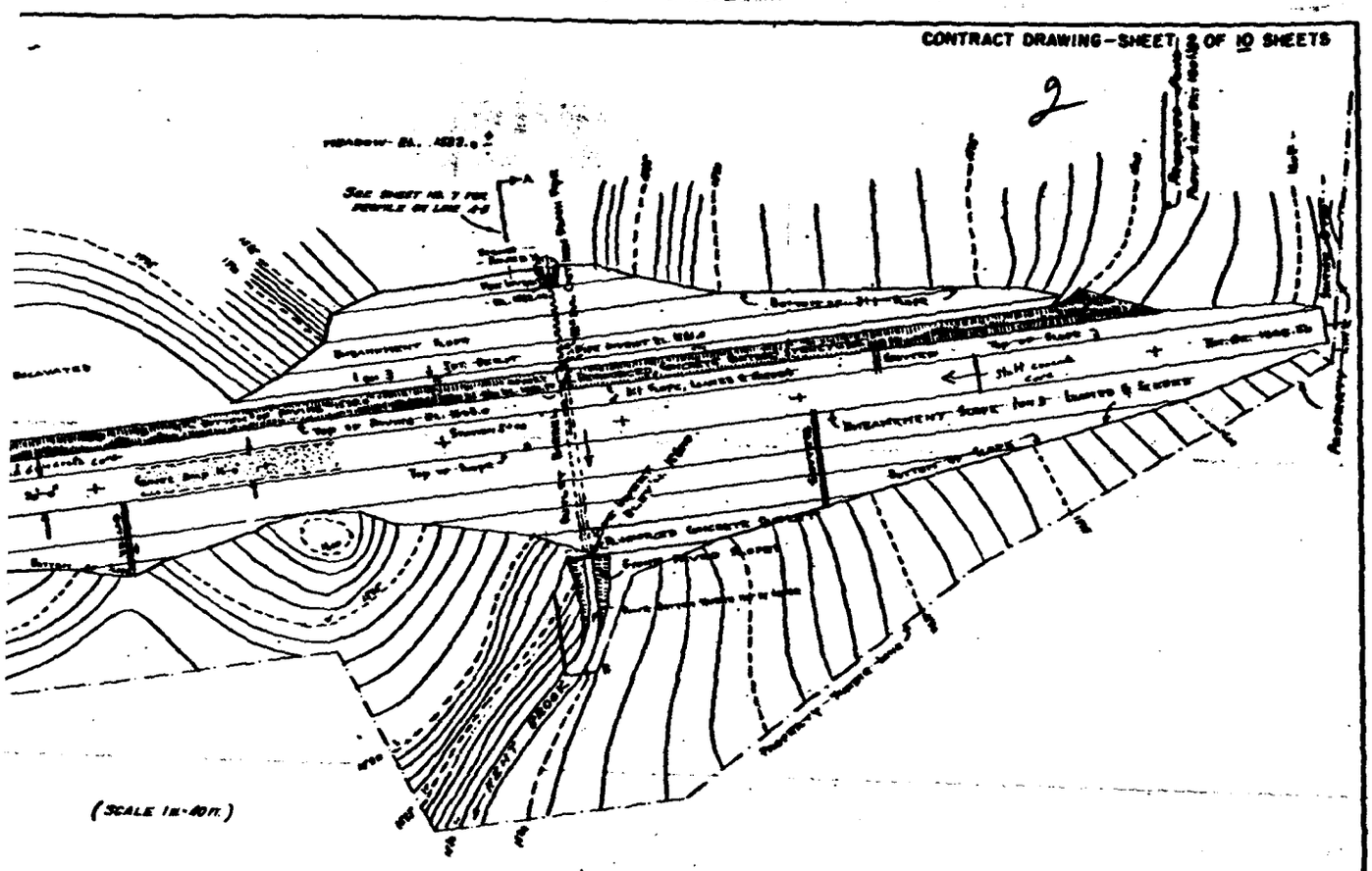
Sherburne

Damage to Emergency Spillway
from Hurricane "Belle"


(SCALE 1in.=40ft.)

CONTRACT DRAWING – SHEET 2 OF 10 SHEETS

2



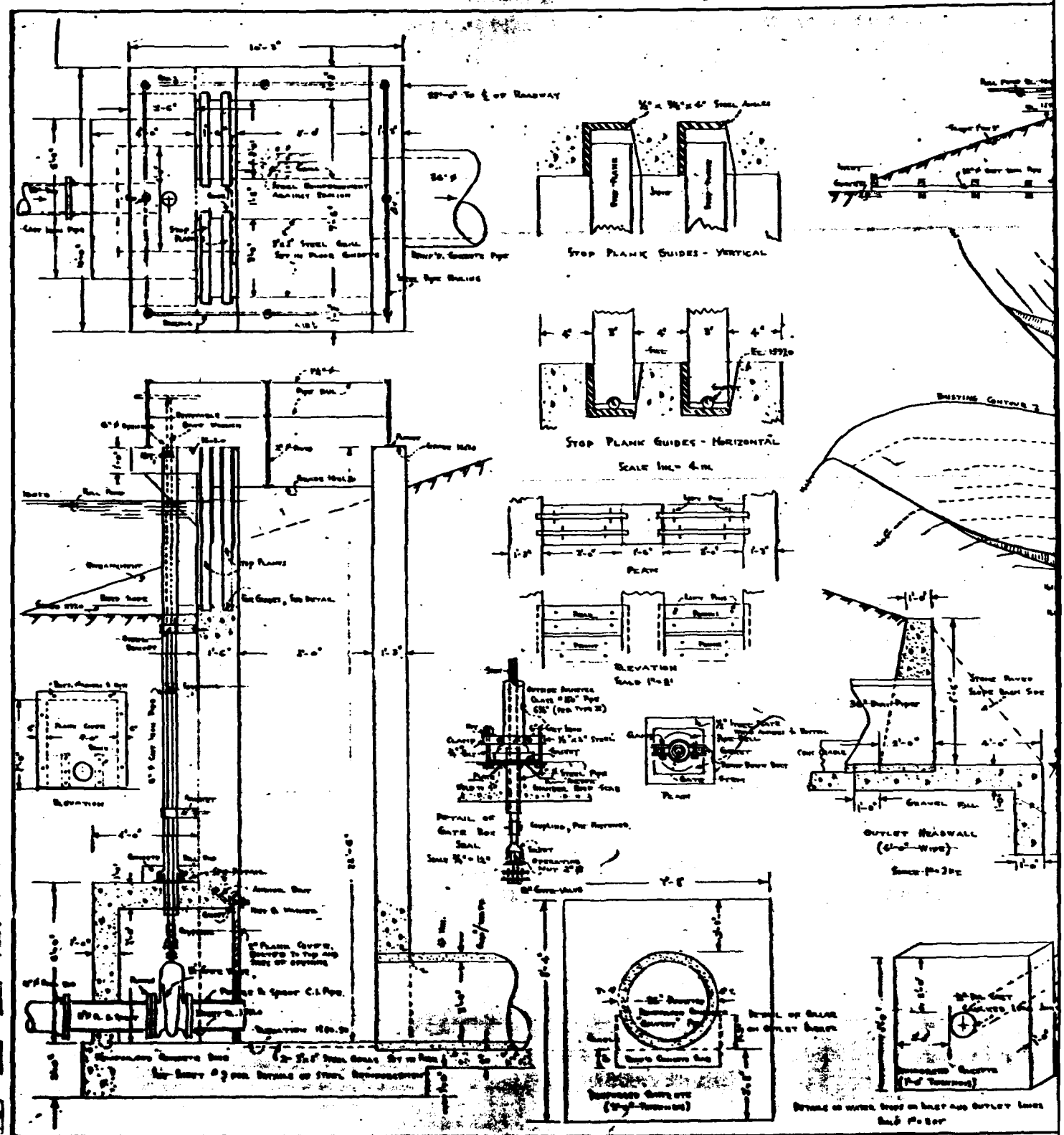
(SCALE 1" = 40 ft.)

REV.	DATE	BY

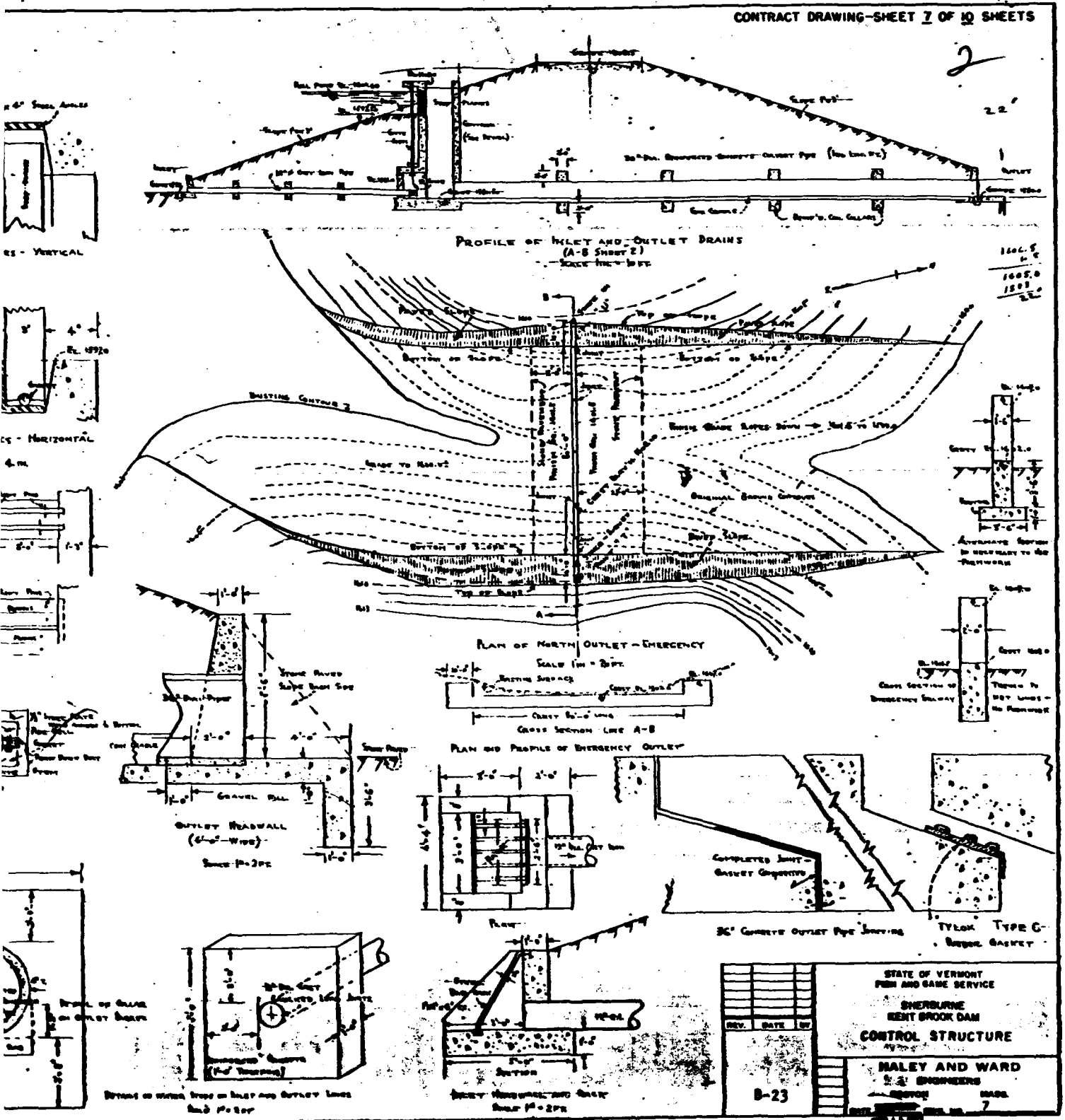
B-22

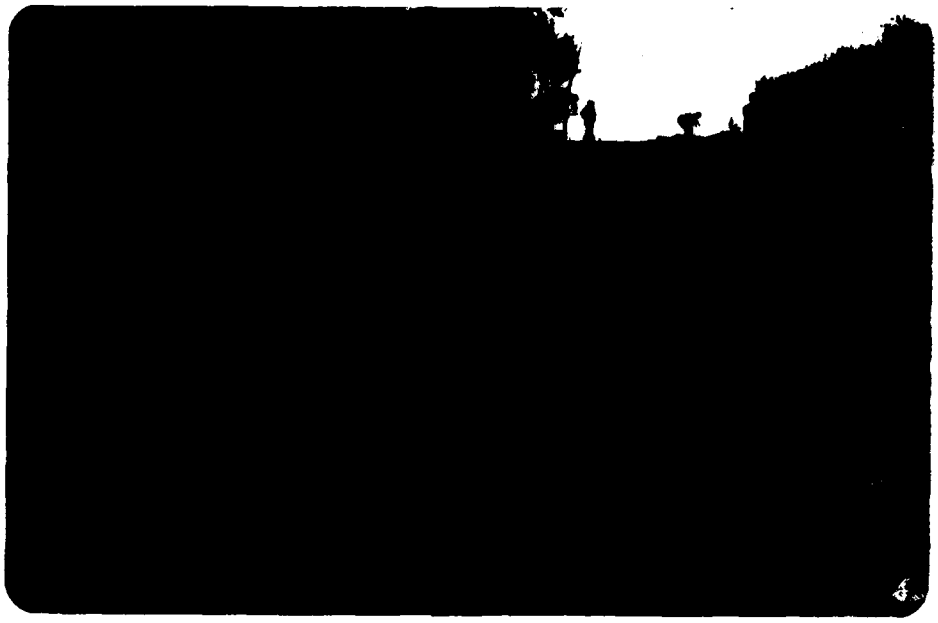
STATE OF VERMONT
FISH AND GAME SERVICE
SHERBURNE
KENT BROOK DAM
GENERAL PLAN
OF
PROPOSED DAM

HALEY AND WARD
ENGINEERING
Boston, Mass.


Stop Plank Guides - Vertical
Stop Plank Guides - Horizontal
Scale 1in = 4in
Plan
Elevation
Scale 1"=1'
Outlet Headwall
Gravel Fill
Bursting Contour

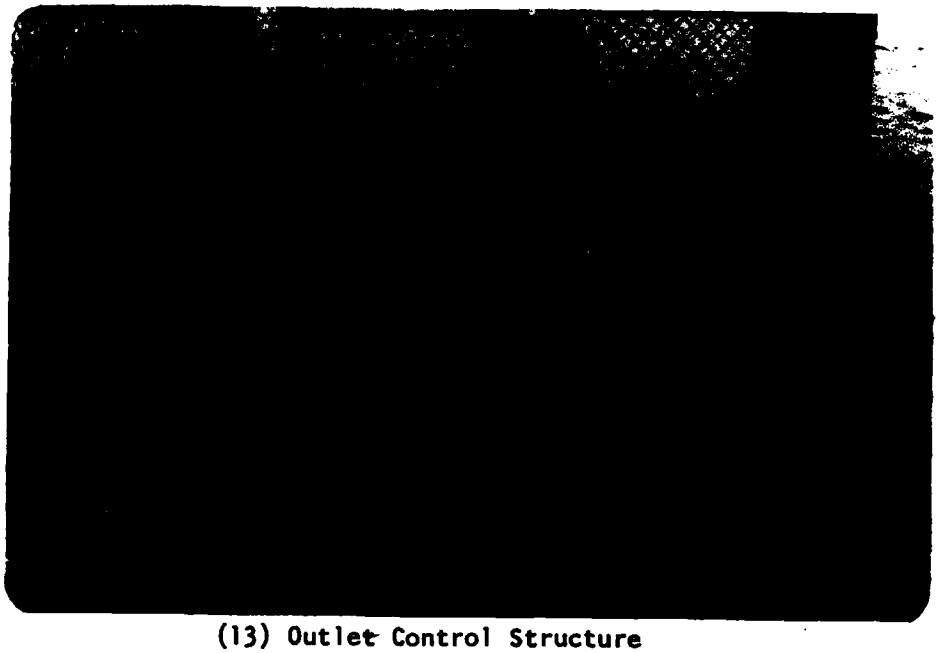
CONTRACT DRAWING–SHEET 7 OF 10 SHEETS



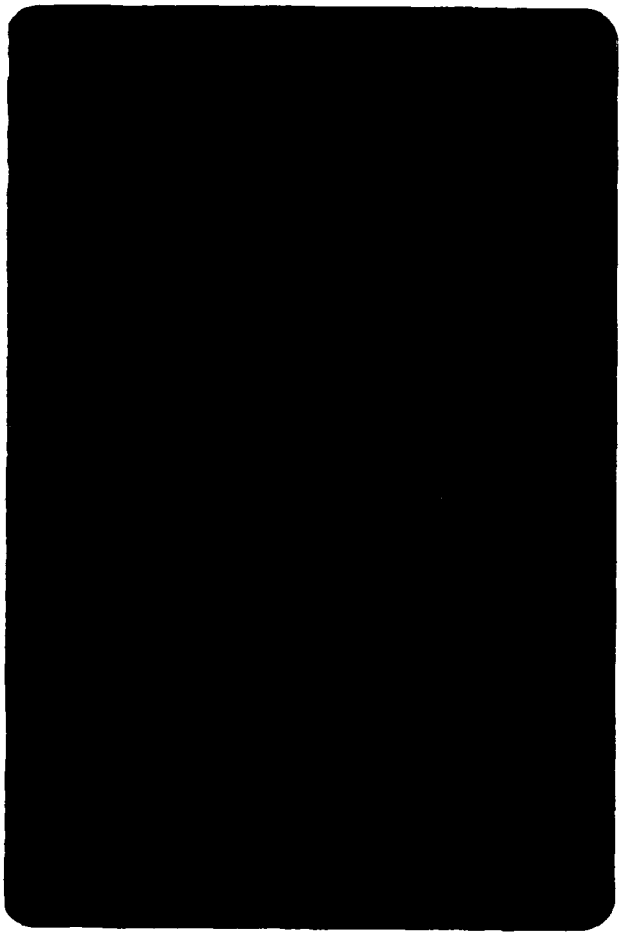


(15) Emergency Spillway Channel

(16) Light Duty Roadway Bridge Over Kent Brook,
3,000 Feet Downstream of Dam

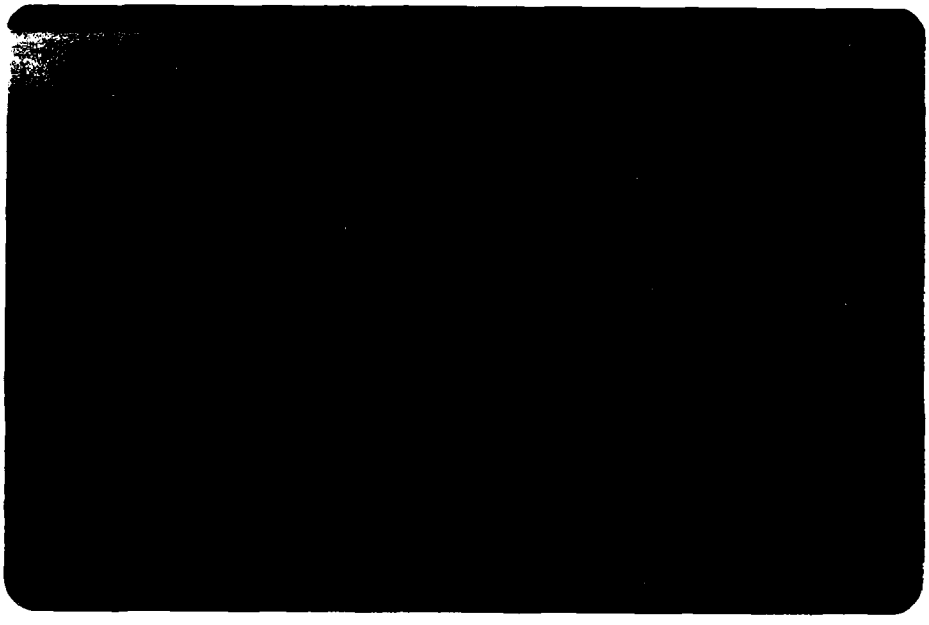


(13) Outlet Control Structure

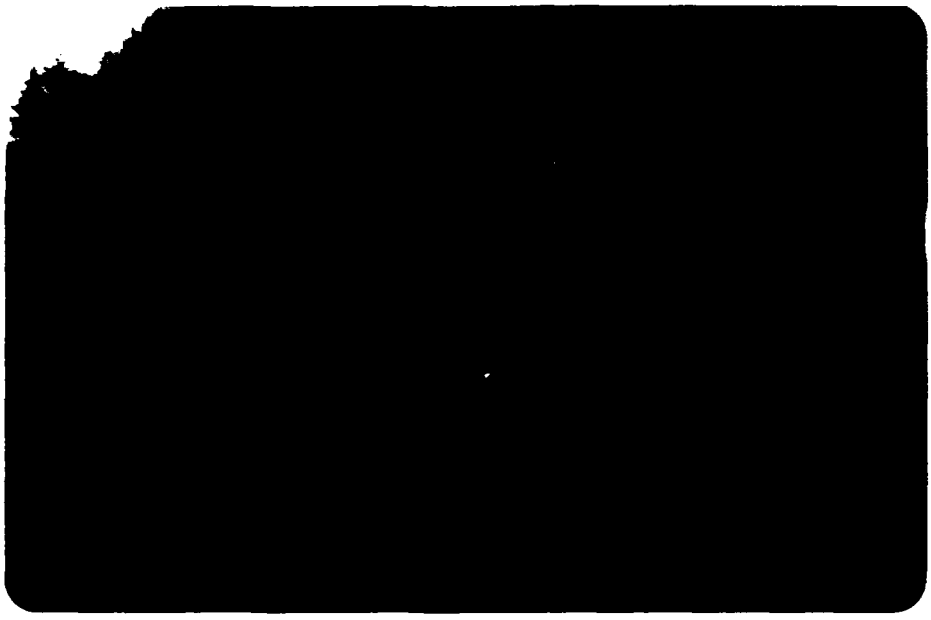


(14) Downstream Channel from Outlet Pipe Headwall

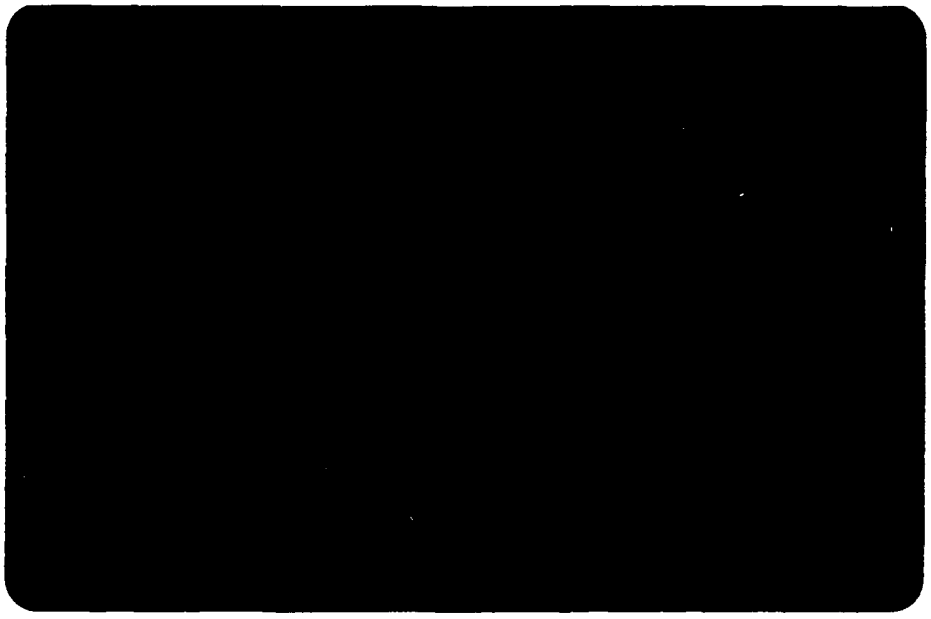
(11) Left Sidewall of Emergency Spillway



(12) Outlet Control Structure

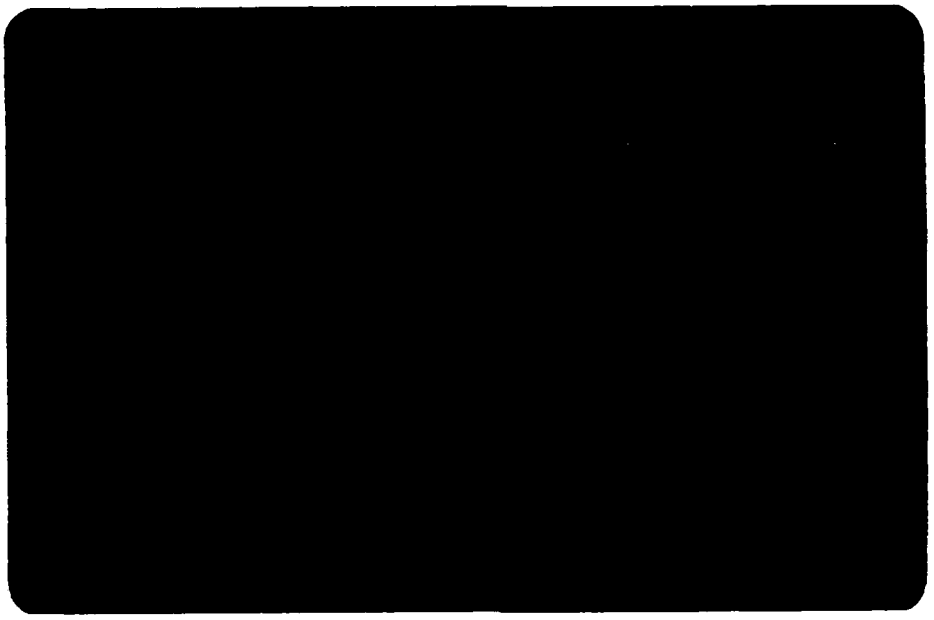


(9) Remote Emergency Spillway at North End of Reservoir

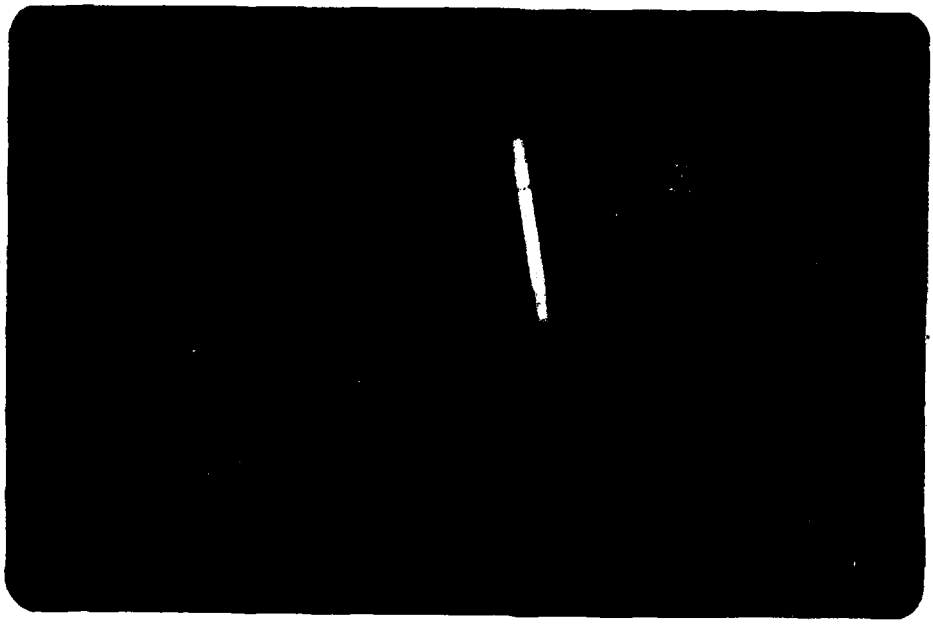


(10) Emergency Spillway Crest and Approach Channel

(7) Wet Area Downstream of Toe, Between Sta. 7+00 and Sta. 8+00



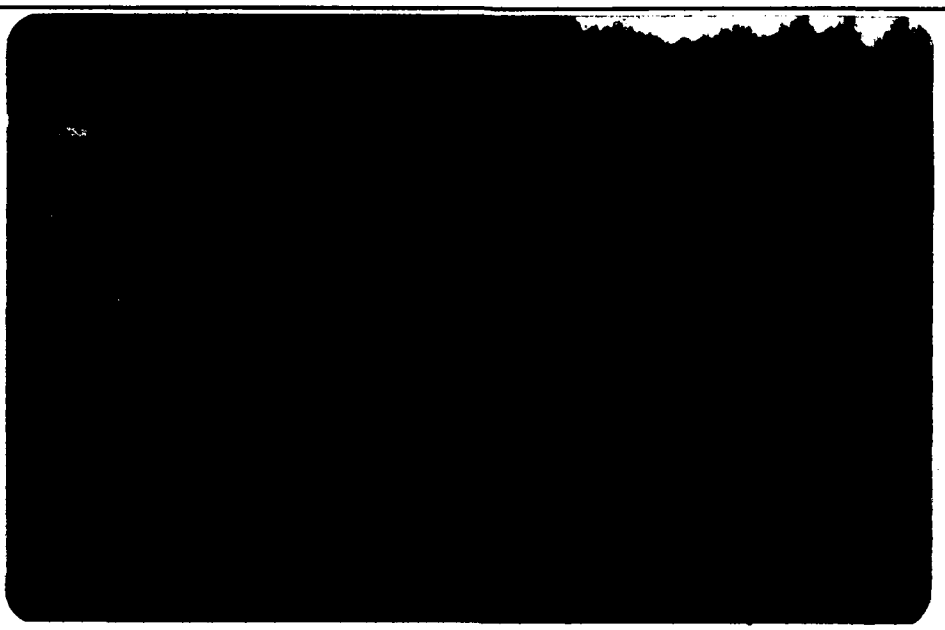
(8) Wet Area Downstream of Toe Near Bend Point of Dam



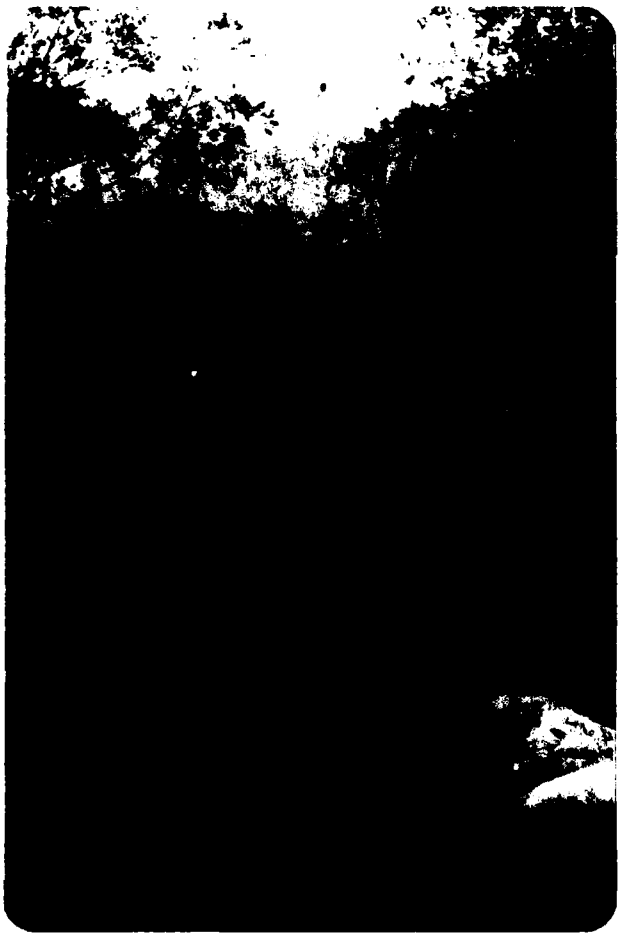
(5) Seepage at Left Side of Outlet Headwall

(6) Wet Area at Contact of Downstream Toe with Left Abutment

U.S. ARMY ENGINEER DIV, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	KENT POND DAM SHERBURNE, VERMONT VT 00017 AUGUST 6, 1980 C- 4
JAMES W. SEWALL COMPANY CONSULTANTS OLD TOWN, MAINE		

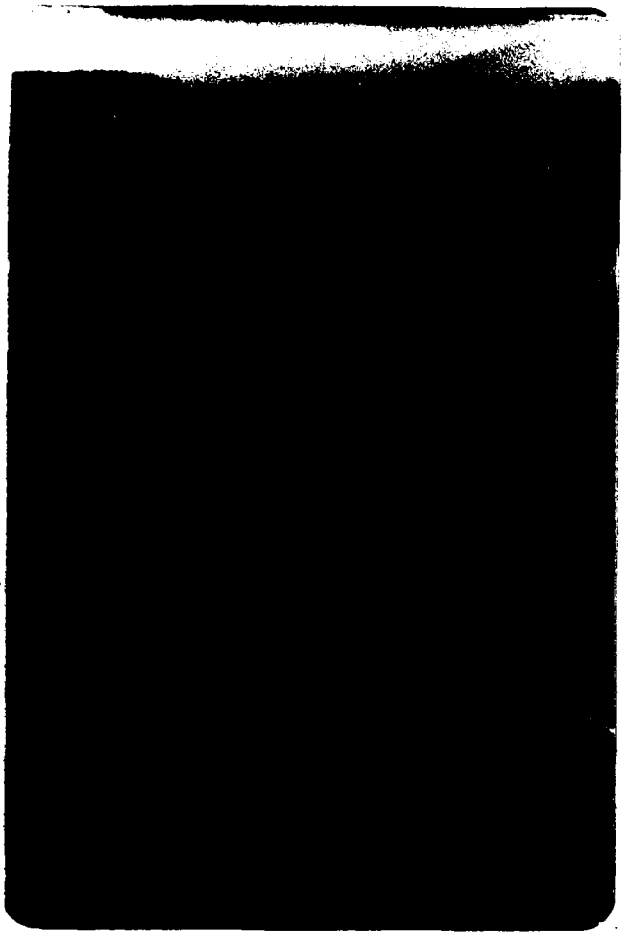


(3) Downstream Slope from Natural Knob of Ground, Looking Toward Left Abutment

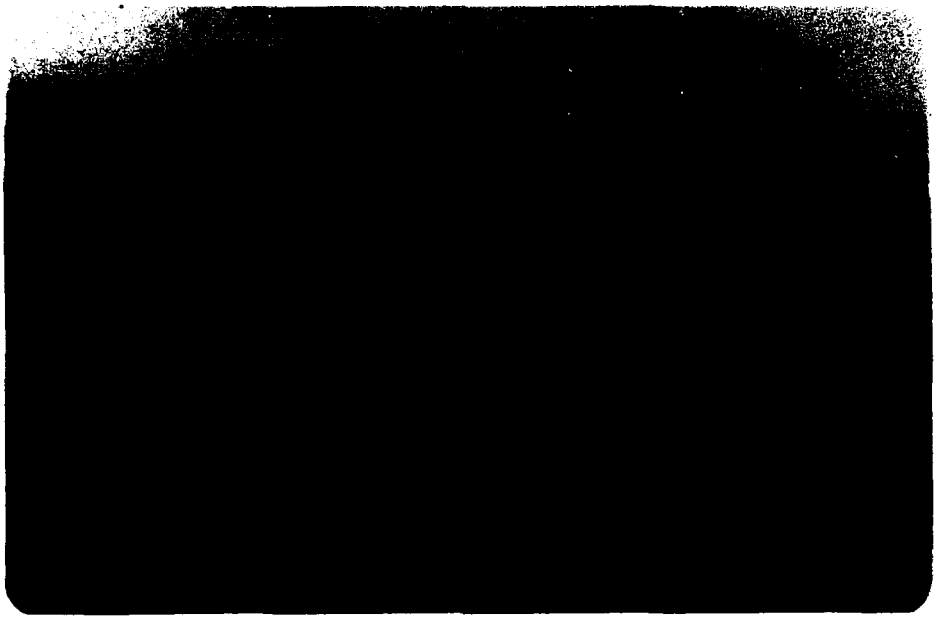


(4) 36" Diameter Outlet Pipe from Control Structure

U.S.ARMY ENGINEER DIV, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	KENT POND DAM SHERBURNE, VERMONT VT 00017 AUGUST 6, 1980
JAMES W. SEWALL COMPANY CONSULTANTS OLD TOWN, MAINE		C-3



(1) Grass Cover and Riprap on Upstream Slope



(2) Paved Roadway on Crest of Dam

U.S.ARMY ENGINEER DIV, NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	KENT POND DAM SHERBURNE, VERMONT VT 00017 AUGUST 6, 1980
JAMES W. SEWALL COMPANY CONSULTANTS OLD TOWN, MAINE		C-2

C-1

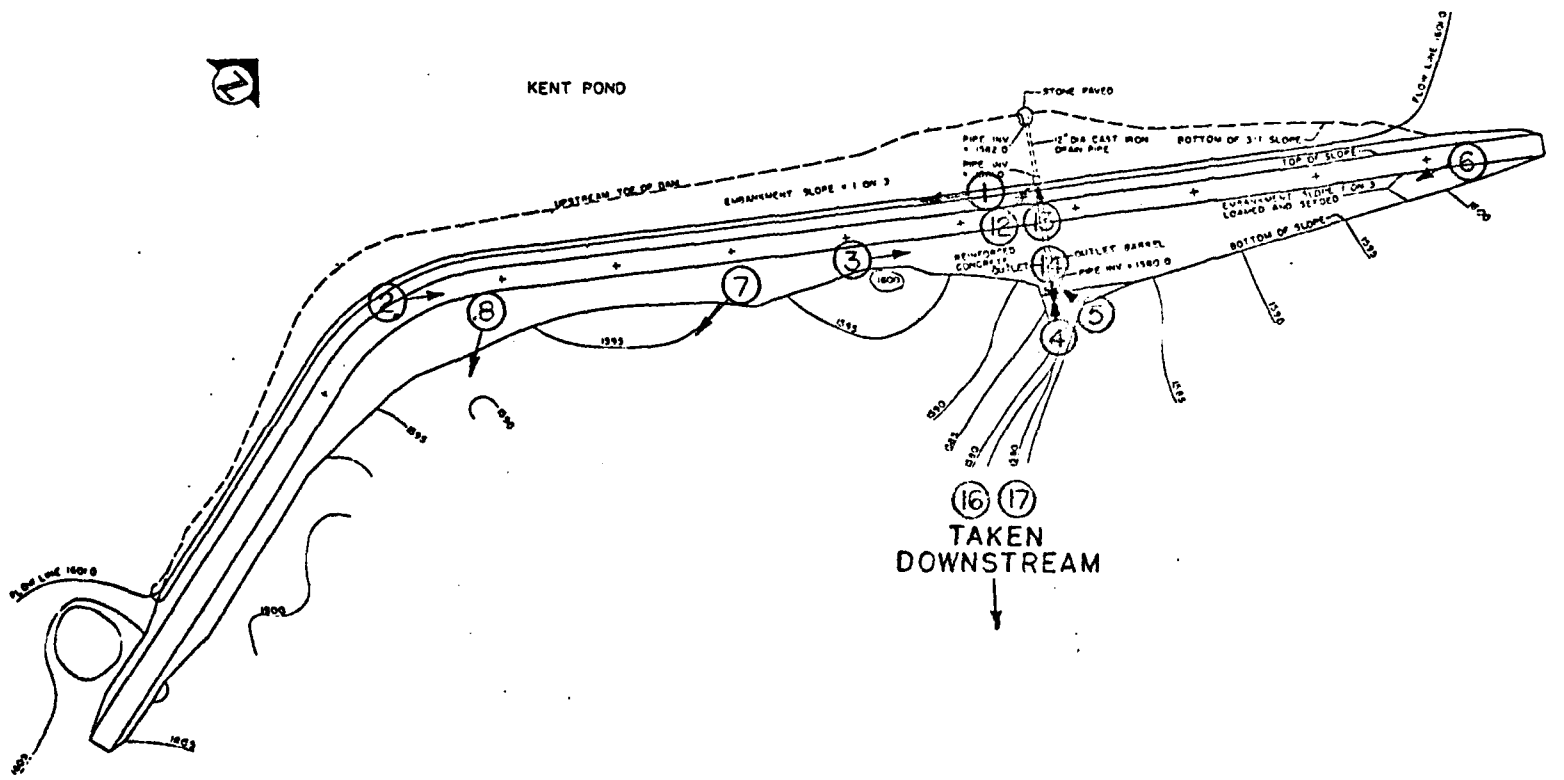
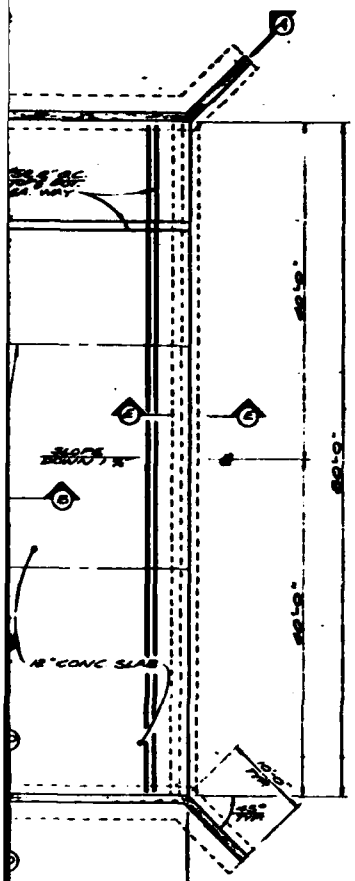
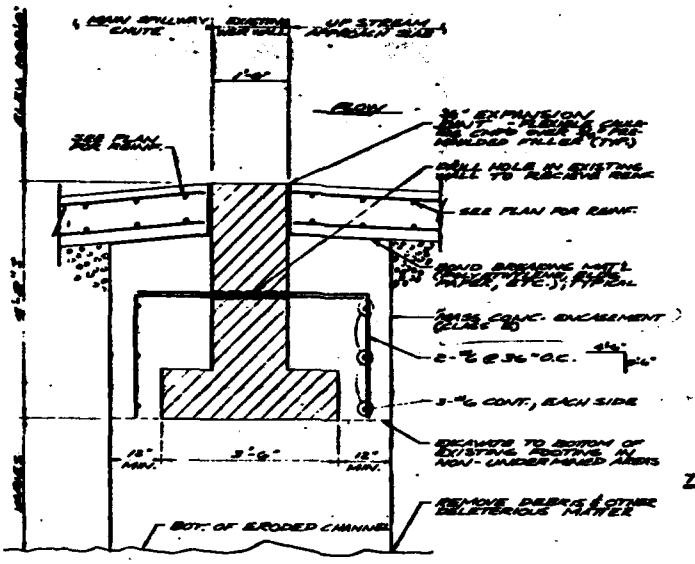


PHOTO LOCATION PLAN

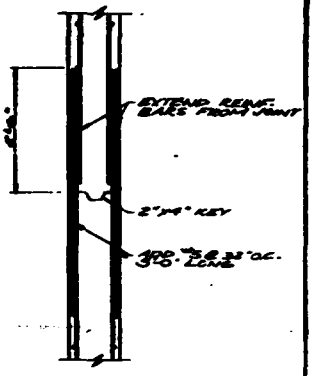
APPENDIX C

DETAIL PHOTOGRAPHS

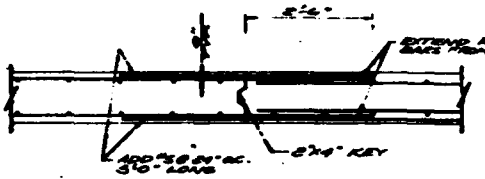




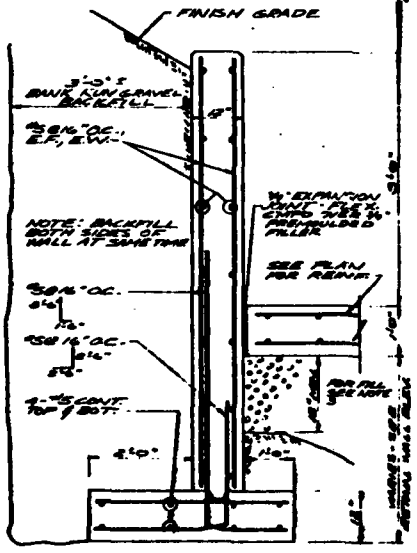
SECTION B-B
TYPICAL CONCRETE ENCASEMENT OF WEIR WALL
3/4"=1'-0"



TYPICAL WALL CONSTRUCT. JOINT
3/4"=1'-0"



TYPICAL FLOOR SLAB CONSTRUCT. JOINT
3/4"=1'-0"



SECTION C-C
TYPICAL RETAINING WALL
3/4"=1'-0"

NOTES

1. ALL CONCRETE SHALL DEVELOP A MIN. ULTIMATE COMPRESSIVE STRENGTH OF 3750 P.S.I. @ 28 DAYS, CLASS A.
2. ALL REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60 WITH A MINIMUM YIELD STRENGTH OF 60,000 P.S.I. ALL BENDING SHALL BE COLD. CONTINUOUS BARS SHALL BE MARKED SYMBOLS OF #4 BAR DIAMETERS UNLESS MARKED OTHERWISE.
3. COMPACTED FILL BENEATH THE BASE SLAB SHALL BE SELECT GRAVEL AS DEFINED IN THE SPECIFICATIONS. SELECT GRAVEL TO BE OF MIN. THICKNESS SHOWN. ALL BACKFILL SHALL BE "RUN OF CRUSHED RUN GRAVEL" AS DEFINED IN THE SPECIFICATIONS.
4. ALL WORK SHALL BE ACCOMPLISHED IN A WORKMANSHIP LIKE MANNER IN ACCORDANCE WITH ACCEPTED STD. PRACTICE.
5. FINISH EXPOSED CONCRETE SURFACES AS FOLLOWS:
   1. HORIZONTAL SURFACES - GOOD SCREED
   2. VERTICAL SURFACES - ALL CAVITIES AND FINS OVER 1/2" SHALL BE CUT BACK AND FILLED WITH CEMENT MORTAR. ALL EXPOSED SURFACES SHALL BE FREE OF FINS, LOOSE EXPOSED AGGREGATE, OR OTHER IRREGULARITIES
6. CHAMFER ALL EXPOSED CONCRETE EDGES 3/4"

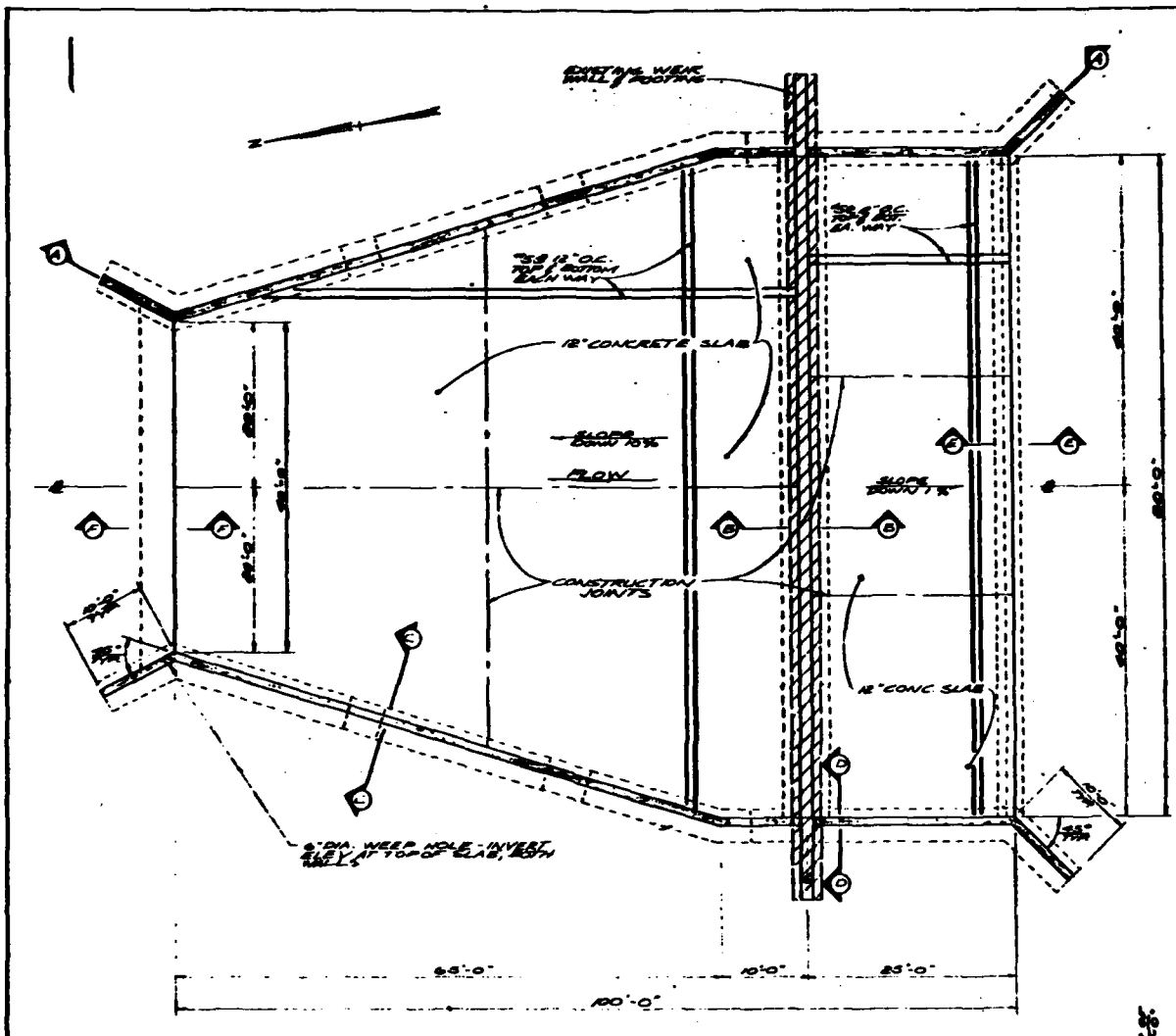
9/24/73
REVISED

NO.	DATE	REVISIONS	BY	APP'D

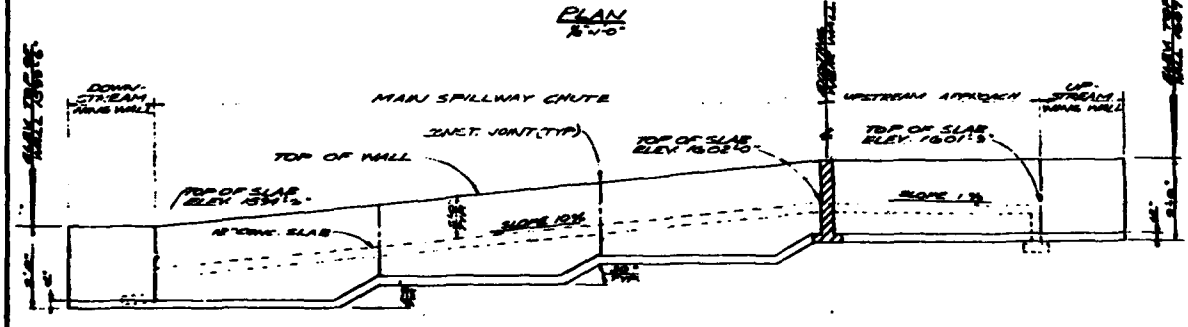
DUBOIS & KING, INC.
ENGINEERS AND CONSULTANTS
RANDOLPH, VERMONT

VERMONT DEPARTMENT OF FISH & GAME
NEW POND EMERGENCY SPILLWAY
STRUCTURAL PLAN AND DETAILS
B-25

DESIGNED BY	DATE
D.D.K.	SEPT. 1973
DRAWN BY	SCALE AS NOTED
	70016
CHECKED BY	SHEET NO.
J.J.S.	2
	SHEET 2 OF 3

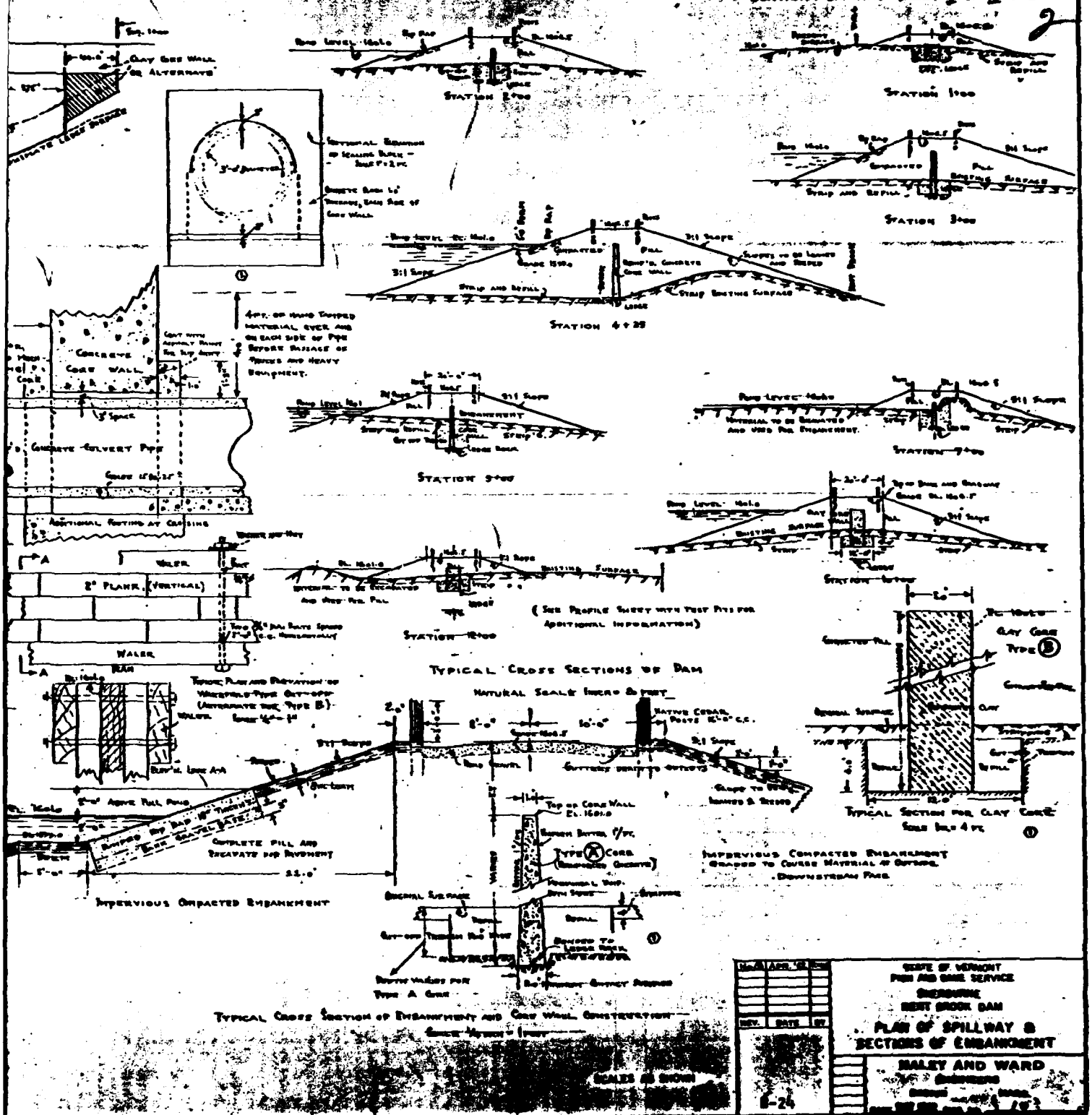


PLAN
3/16"=1'-0"



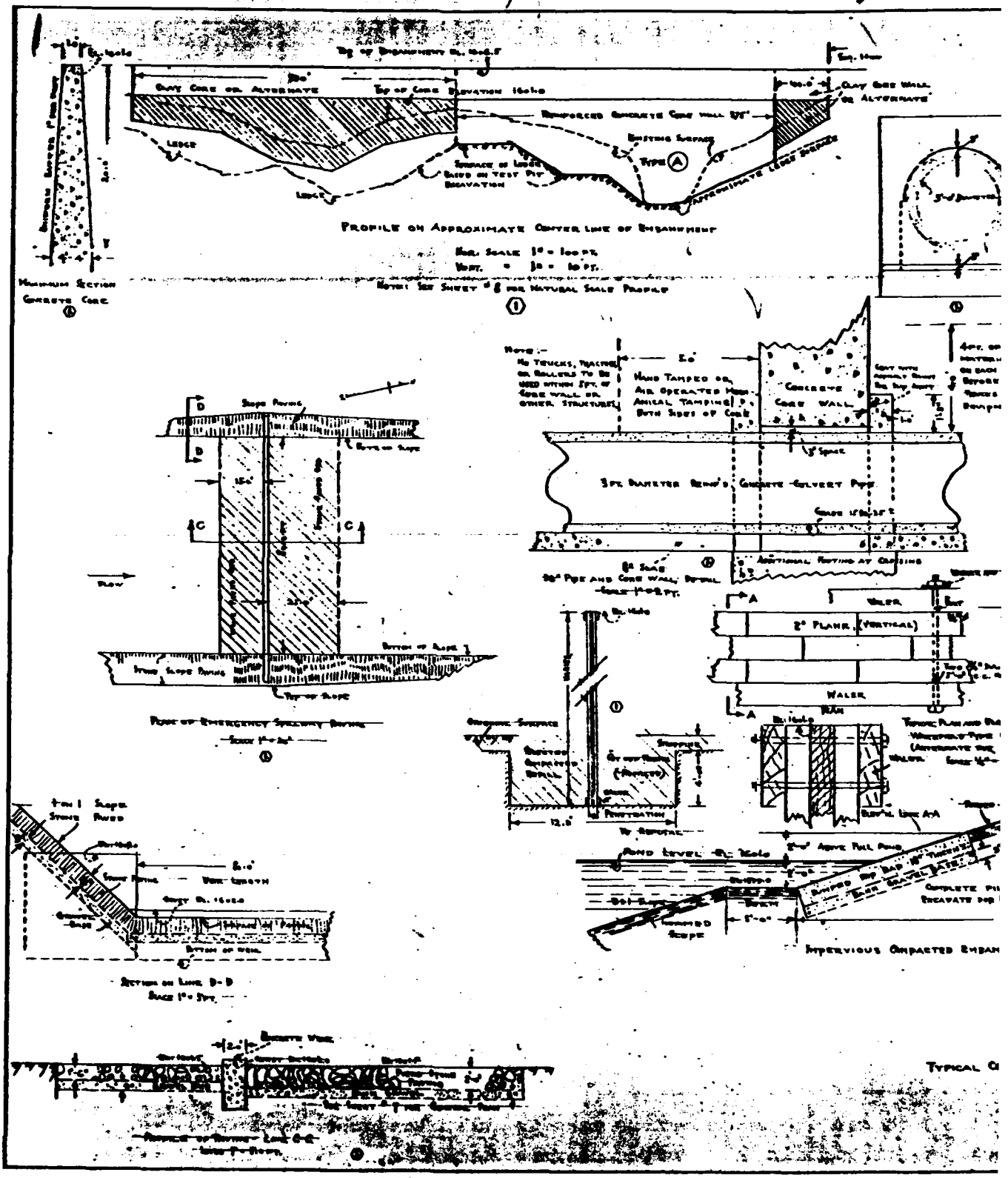
SECTION A-A
RETAINING WALL ELEVATION
3/16"=1'-0"

CONTRACT DRAWING - SHEET 5 OF 10 SHEETS



STATE OF VERMONT
FISH AND GAME SERVICE
SHERBURNE
REST BROOK DAM
PLAN OF SPILLWAY & SECTIONS OF EMBANKMENT
HALEY AND WARD
Engineers

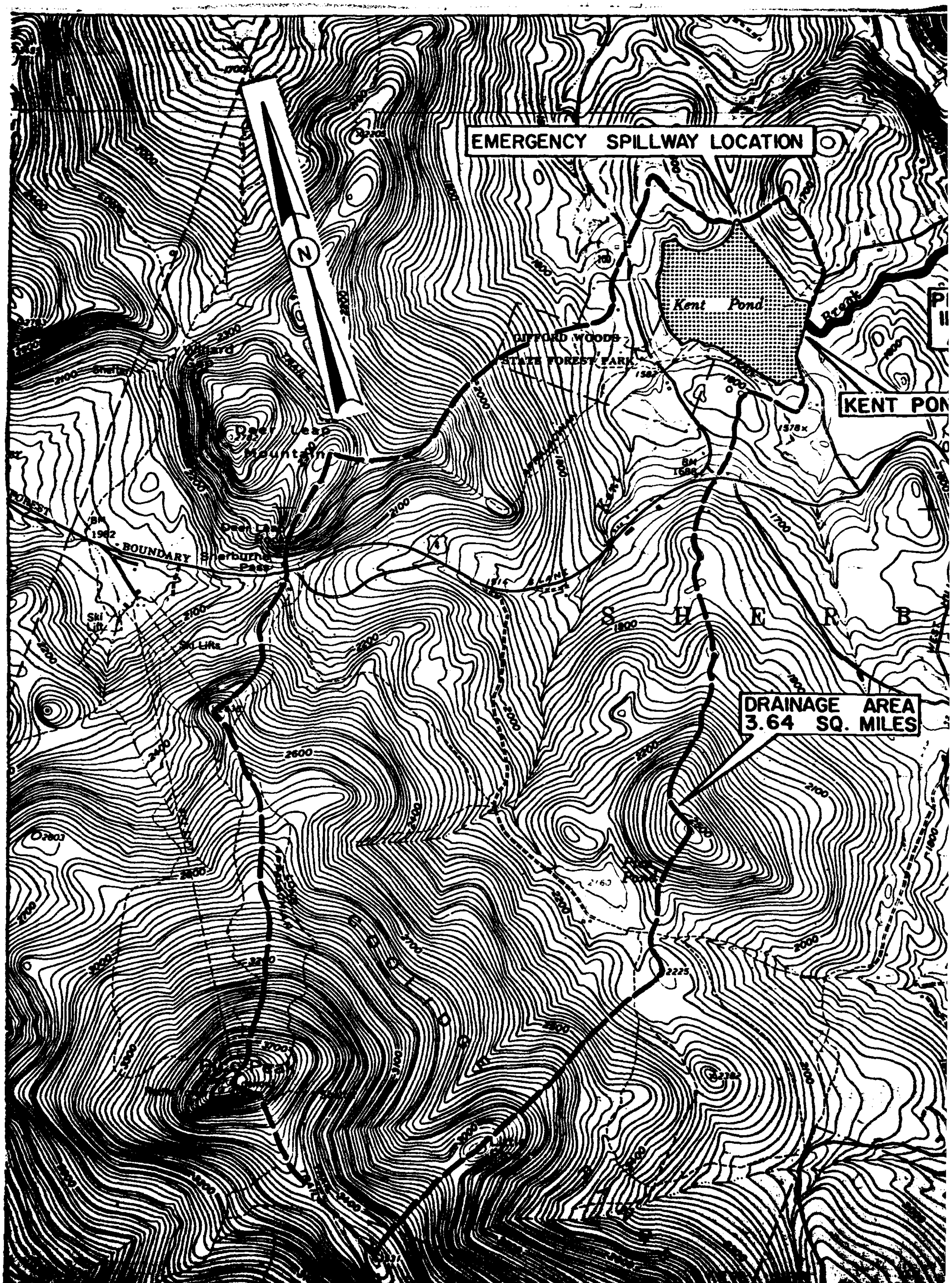
E-24

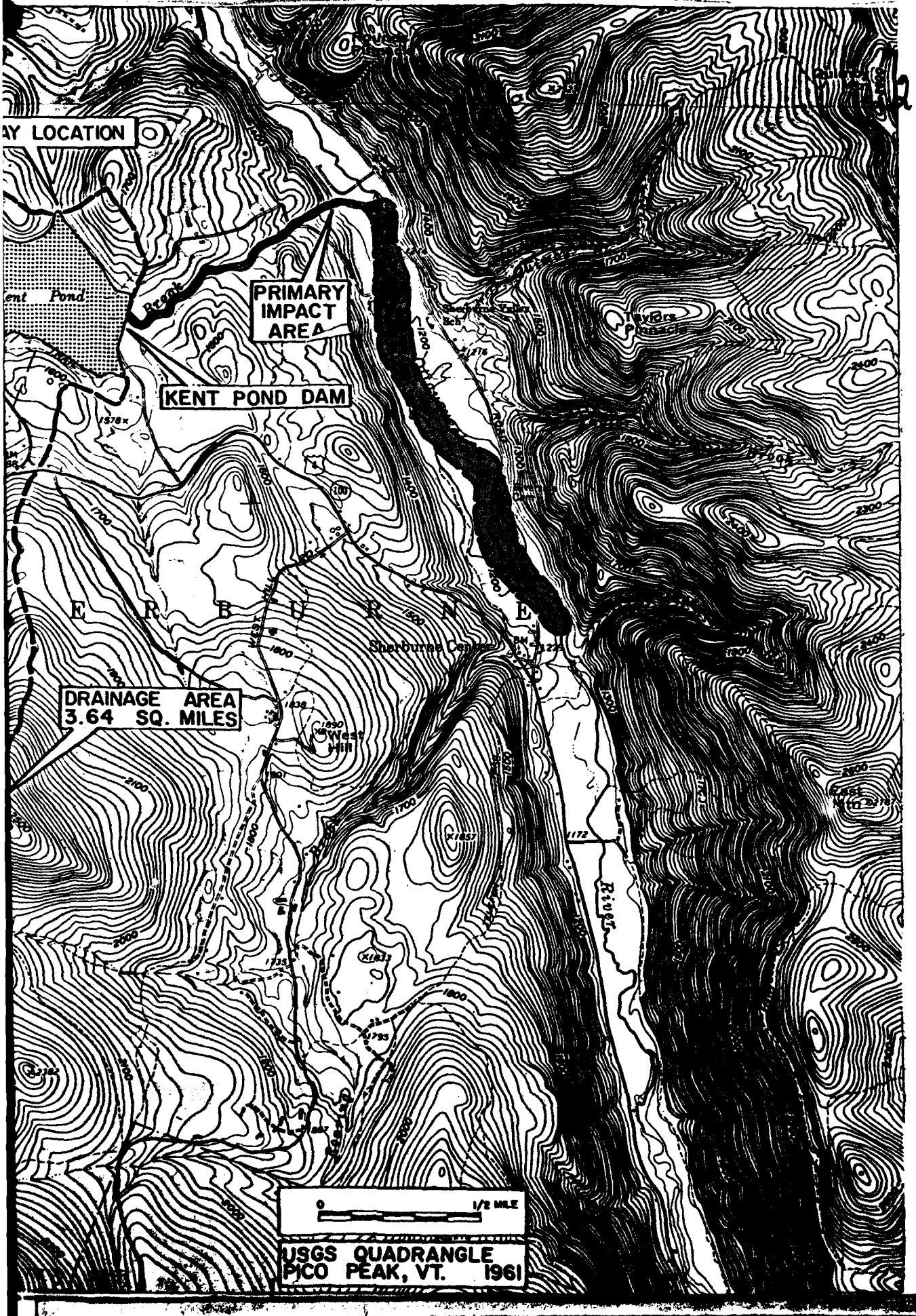

Profile on Approximate Center Line of Embankment
Horiz. Scale 1" = 100 ft.
Vert. " 10 = 10 ft.
Maximum Section Concrete Core
Note: See Sheet # 8 for Natural Scale Profile
Clay Core or Alternate
Reinforced Concrete Core Wall
Existing Surface
Type A
Ledge
Clay Core Wall or Alternate
Hand Tamped or Air Operated Mechanical Tamping Both Sides of Core
Concrete Core Wall
Concrete Culvert Pipe
Additional Fitting at Crossing
Slope Paving
Bottom of Slope
Top of Slope
Flow
Plan of Emergency Spillway Paving
Waler
Plank (Vertical)
Penetration
Pond Level
Impervious Compacted Embankment
Section on Line B-B
Typical

(17) House and Concrete Training Wall Adjacent to Kent Brook, 3,750 Feet Downstream of Dam

APPENDIX D

HYDRAULIC/HYDROLOGIC COMPUTATIONS


EMERGENCY SPILLWAY LOCATION
Kent Pond
GIFFORD WOODS
STATE FOREST PARK
KENT PON
DRAINAGE AREA
3.64 SQ. MILES
N
Deer Leap Mountain
Sherburne Pass
BOUNDARY
Ski Lifts
S H E R B


AY LOCATION
PRIMARY IMPACT AREA
KENT POND DAM
DRAINAGE AREA 3.64 SQ. MILES
E R B U R N E
Sherburne Valley
Taylors Pinnacle
West Hill
East Hill
Sherburne Pass
River
1/2 MILE
USGS QUADRANGLE
PICO PEAK, VT. 1961

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 1 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Sherburne, Vt Job No. 953-05 I

Computed by MFB Checked by SDM Date 10-2-80

Hydrologic / Hydraulic Inspection

I Performance at Test Flood Conditions

1) Maximum Probable Flood

a) Watershed classified as "Mountainous"

b) Watershed area = 3.64 square miles

c) From NED-ACE Preliminary Guidance for Estimating Maximum Probable Discharges Guide curve for PMF Peak Flow Rates:

PMF = 2330 cfs / square mile

d) Peak Inflow

2330 cfs x 3.64 sq. miles = 8481 cfs @ PMF

Similarly, 4241 cfs @ ½ PMF

Ice yr [illegible] = 1/4 PMF = 16.3 in

Ratio of Probable Maximum 6-hour Precip for 10 Square Miles to 10-year 6-hour Precip

Weather Bureau TP 40, p. 58 - [illegible]

2) Test Flood

a) Classification of Dam according to NED-ACE Recommended Guidelines

i) Size: Storage (max) = 1410 acre-ft

[illegible] = [illegible]

D-2

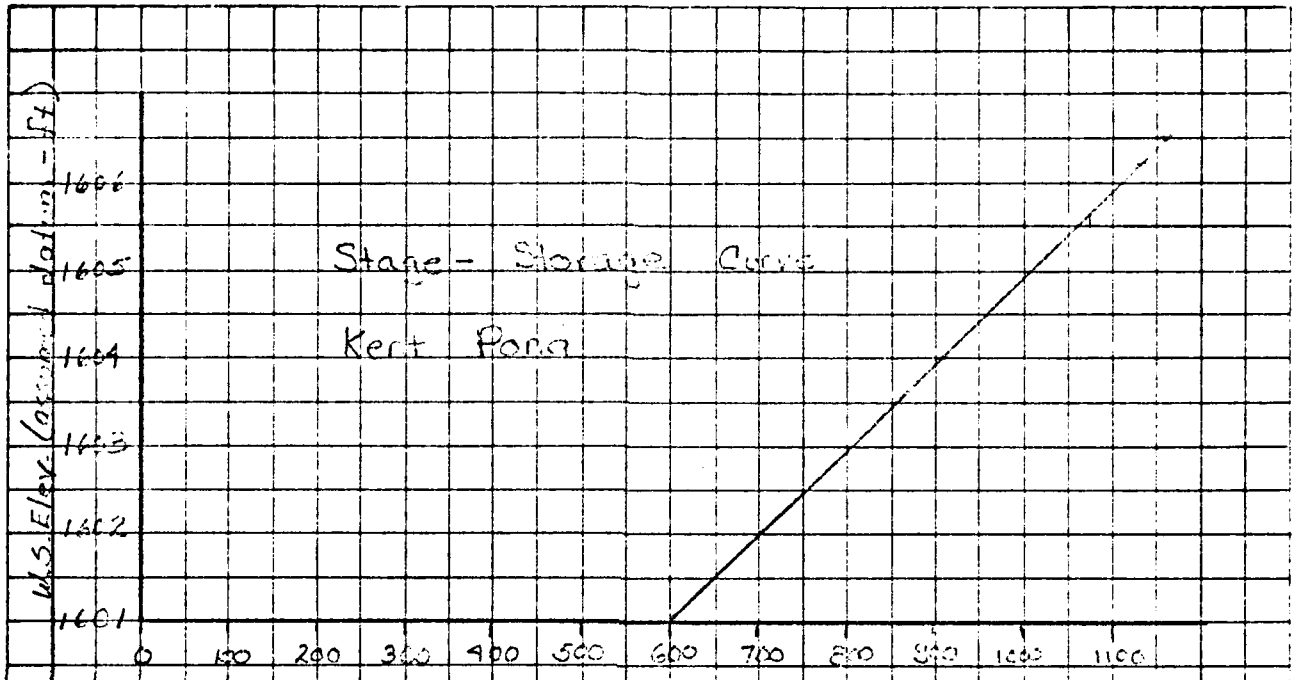
JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 2 of 31

Subject Inspection of non-federal [illegible]

Computation Part 7 A Spillway Design Job No. [illegible]

Computed by MEB Checked by SDK Date 10-2-80



Stage - Storage Curve

Kent Pond

Pond Area = 101.5 acres at summer pool level 1601.0

from Vt. Dept of Water Resources Table Sheet

Assume [illegible] acre-ft at spillway @ 1601 - Vt Dept Water Res

[illegible] → [illegible] + 600 = 1100 acre-ft

(c) Hazard Potential:

[illegible]

(d) [illegible]

[illegible]

D-3

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 3 of 31

Subject Inspection of [illegible]

Computation Kent Pond Job No. 953-05 I

Computed by mrb Checked by SDM Date 10-13-[illegible]

b) Test Flood = [illegible] cfs

3) Surcharge at Peak Inflow

a) Test Flood = ½ PMF Q_p = [illegible] cfs

b) Out flow Rating Curve

Primary Spillway

Sharp crested $L = 10$

$Q = CLH^{3/2}$ $C = 3.8$

H	Q	W.S. El
.5	12	1602
1.5	61	1603
2.5	130	1604
3.5	218	1605

Broad crested $L = 7.5$

$Q = CLH^{3/2}$ $C = 2.6$

H	Q	W.S. El
1	25	1604
2	72	1605

Stoplog Section

[illegible] spillway [illegible] flow between stoplogs and bottom of [illegible] weir flow over concrete dam [illegible] applies some as below.

Outlet Pipe 3' Diameter Invert El = 1580.0

$H = h_{ent} + h_f + h_{exit}$

$h_f = f \frac{L}{D} \frac{v^2}{2g}$ $f = \frac{29 n^2}{R^{1/3}}$ $n = .014$ $R = .25$ $L = 100'$ $D = 3'$

$h_{ent} = .10\, v^2/2g$ (Corrugated pipe, slightly rough) $h_{exit} = 1.0\, v^2/2g$

H	V	Q	W.S. El
19	25.16	173	1602
20	25.81	182	1603
21	26.45	187	1604
22	27.07	191	1605
[illegible]	[illegible]	[illegible]	[illegible]
25	29.05	204	1609

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 4 of 31

Subject Inspection of non-federal dam

Computation Kent Pond Job No. 953-05 I

Computed by MEB Checked by Date 10-13-80

Outflow Rating Curve cont

Emergency Spillway crest el. 1602 L=80 c=3.2 $Q=CLH^{3/2}$

H	Q	WS El	H	Q	WS El
1	256	1603	1.5	2444	1606.5
2	724	1604	5	2862	1607
3	1330	1605	5.5	3302	1607.5
4	2029	1606	6	3762	1608

Top of Dam crest el 1606.5 L=1190 left side 50:1 slope
right side 4.5:1 slope
$Q=CLH^{3/2}$ c = 1.0 (from [illegible])

H	Q	WS El
.5	539	1607
1.0	1523	1607.5
1.5	2912	1608

Emergency Spillway sidewall el. 1607 left slope 1:9
right slope 1:6
[illegible]

H	Q	WS El
.5	3	1607.5
1.0	11	1608

Rating Curve

WS El	Q	WS El	Q
1601	0	1605	1521
1602	12	1606	2244
1603	317	1607	3601
1604	994	1607.5	5060

The outflow rating curve is plotted on page 5

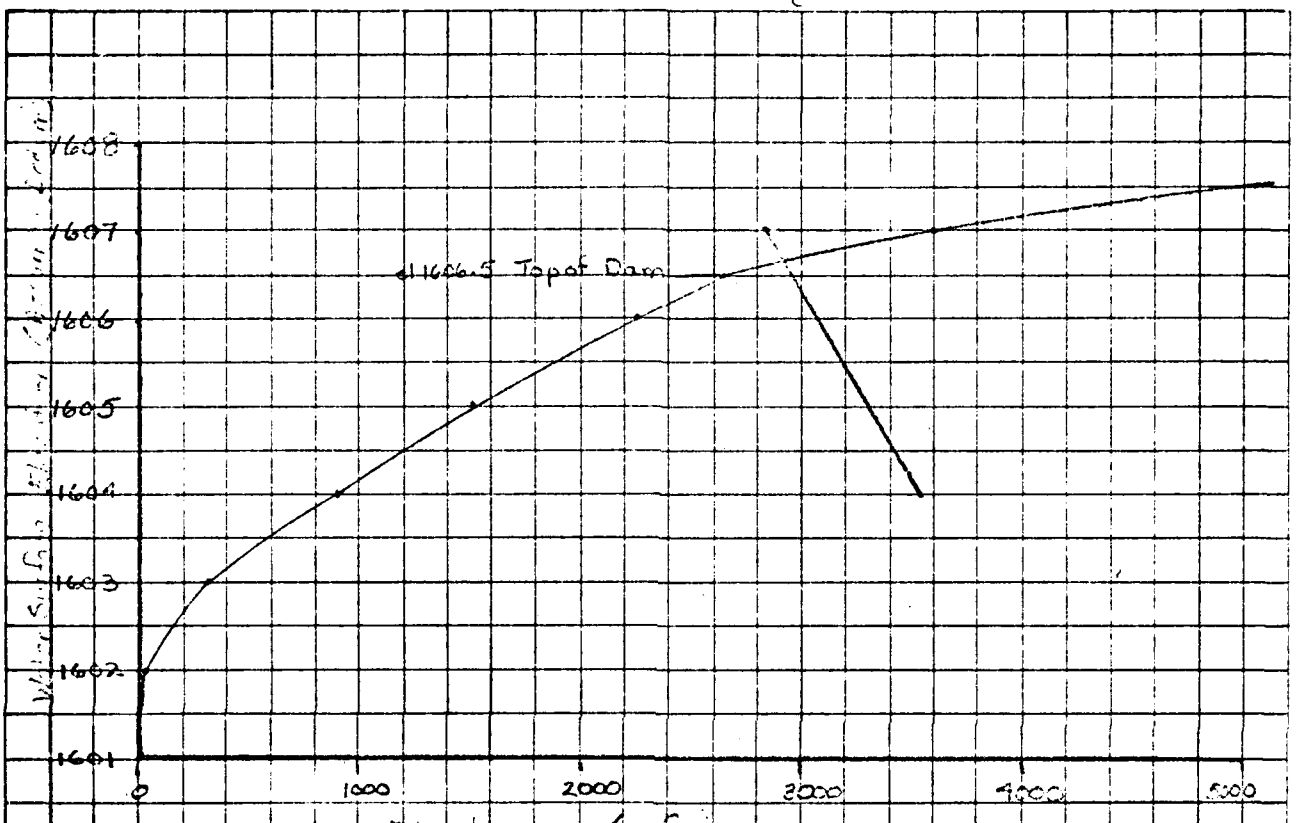
JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 5 of 31

Subject Inspection of non-[illegible] Dam

Computation Kent Pond Job No. 253-07

Computed by [illegible] Checked by SDM Date 12-12-83



a) Spillway capacity to top of dam

ws el = 1606.5 Q = 2640 cfs ± 32% Q_{p_1}

d) Surcharge height to pass Q_{p_1}

Q_{p_1} ½ PMF = 4291 cfs H = 6.25' (above spillway crest elevation)

4) Effect of Surcharge on Maximum Probable Discharge

a) [illegible] Flow [illegible] = 1414 cfs

b) Assume normal pool level at [illegible]

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 6 of 31

Subject Inspection of [illegible]

Computation [illegible] Job No. 953-05 I

Computed by [illegible] Checked by SDM Date 10-13-9[illegible]

c) Watershed area = 3.64 mi²

d) Discharge (Q_{p_2}) at various surcharge elevations:

H = 6' V = 101.5 acres × 6' = 609 acre-ft
S = 609 / (53.3 × 3.64) = 3.14"

H = 3' V = 101.5 acres × 3' = 304.5 acre-ft
S = 304.5 / (53.3 × 3.64) = 1.57"

From Approximate Storage Routing Guidelines (for Probable P.M.F. in New England)

$Q_{p_2} = Q_{p_1}(1 - S/5.5)$ for Q_p = 1/2 PMF Q_{p_1} = 4241 cfs

H = 6' Q_{p_2} = 2839 cfs
H = 3' Q_{p_2} = 3537 cfs

e) Peak Outflow (Q_{p_3})

Using NED-ACE Guidelines "Surcharge Storage Routing Alternate Method"

Q_{p_3} = 2230 cfs H = 5.7' for Q_p = 1/2 PMF ✓

f) Spillway capacity to outflow

Q_s = 2140 ± 90% Q_{p_3} ✓

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 7 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by MFB Checked by SDH Date 10-13-95

Summary

a) Peak Inflow
Test Flood = ½ PMF = 4,491 cfs

b) Peak Outflow
Q_{P3} = 2930 cfs @ ½ PMF

c) Spillway Max Capacity
Q_S = 2640 cfs
At Test Flood = ½ PMF, the dam is overtopped by 0.20 feet (WSE ≈ 1606.7) or to an average surcharge above the max. height of stoplogs (@ 1606.5) of 5.7 feet.

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 8 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by MEB Checked by SDH Date 10-13-81

II Downstream Failure Hazard

1. Peak Failure Outflow

a) Breach Outflow

i) Mid-Height EL = 1606.5 - 26.5 = 1593.25

ii) Approx mid-height length = 1200'

iii) Breach width
W_b = 2.4 x 1200 = 480'

iv) Assume overtopping to top of dam
$\therefore h_o$ = 26.5'

v) $Q_b = 8/27\ W_b \sqrt{g}\ h_o^{3/2}$
= 110,100 cfs ✓

b) Remaining Spillway Flow

- Assume breach occurs in area of principal spillway
- Emergency spillway starts flow @ = 2444 cfs
bypassed flow = 1 - 2444 = -1344 cfs
all flow passes through breach & principal spillway

c) Peak Failure Outflow = 110,100 cfs

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 9 of 21

Subject Inspection of [illegible] dams

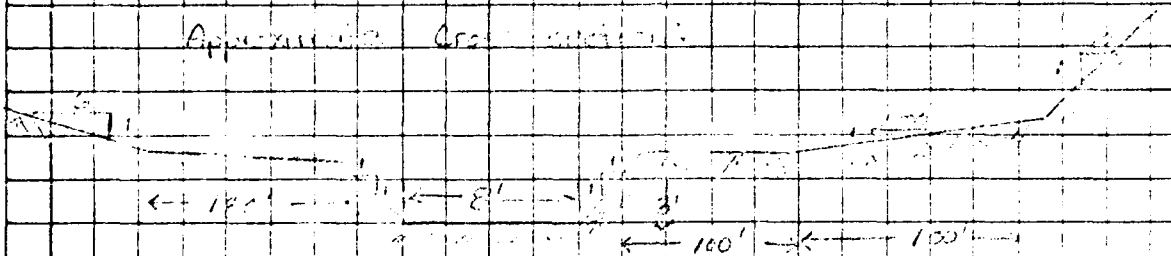
Computation [illegible] Job No. 953-85 [illegible]

Computed by MEF Checked by SDM Date [illegible]

2. Dra[illegible] Bl[illegible] Equation + Prob. Flood Stage

a) 0 - 1500 ft D/S [illegible] Dam

Approx. Cross [illegible]



V = 1.49 $R^{2/3} S^{1/2}$ S = [illegible]

[illegible]

H			P	V	Q
1	9	16.93	.82	3.70	34
3	33	16.99	2.00	6.21	205
4	47	16.[illegible]	[illegible]	8.61	405
6	75	16.83	4.95	11.76	[illegible]
8	103	16.89	6.27	14.55	1497
10	131	16.89	7.95	17.[illegible]	2286
12	159	16.89	[illegible]	19.41	3089
14	187	16.89	[illegible]	21.[illegible]	4045
16	215	[illegible]9	13.69	[illegible]	5104
18	[illegible]	[illegible]89	14.14	[illegible]	6259
20	271	[illegible]89	16.44	27.76	7506
22	299	16.[illegible]	17.89	29.31	8697
24	319	16.[illegible]	19.35	30.[illegible]	9851

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 10 of 31

Subject

Computation

Job No.

Computed by

Checked by

Date 10-13-20

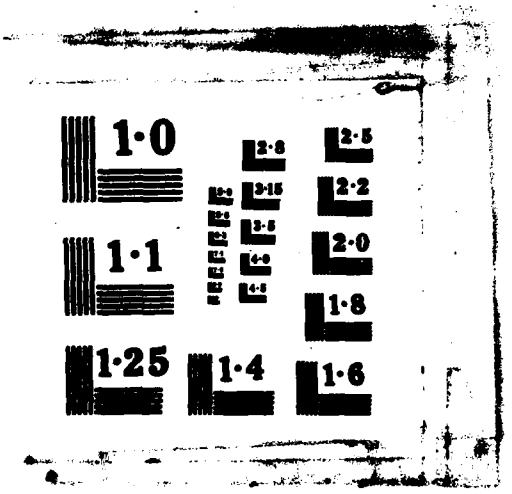
4	1350				
6			3.42		
8			4.13		
10					
12					
14			2.49		
16					
18	3375				
20			13.[illegible]		
22			15.29	10.[illegible]	
24					

4	150			.41	212
6	519				
8			4.29	4.52	4659
10			5.15	5.58	8540
12			7.33	6.60	13450
14			8.30	7.31	19335
16			10.20	9.01	26350
18			11.51	9.75	34424
20					43401
22					
24					

D-11

AD A156 744 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
KENT POND DAM (VT 000..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV JUN 81

UNCLASSIFIED F/G 13/13 NL


1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5

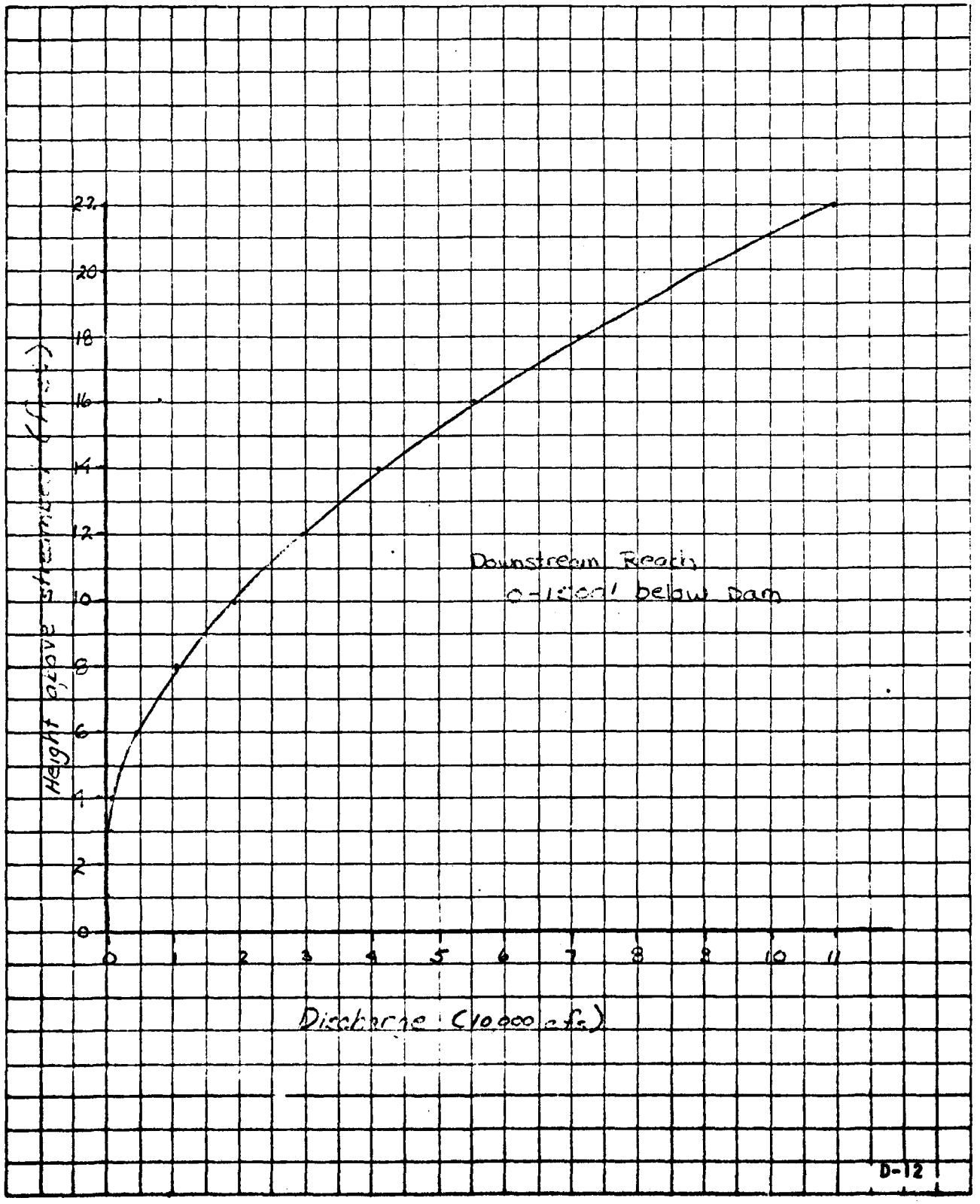
JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 11 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by MEB Checked by SDM Date 10-13-80



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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05.I

Computed by RFB Checked by SDM Date 10-13-85

Downstream Reach 0-1500' below dam

Reservoir storage at time of failure = 1160 acre-ft

Pre-failure flow = 198 cfs (pond, spillway, emergency spillway, dam not discharge to Kent Brook)

H = 2.7' V = 1 acre-ft

Failure flow = 110,100 cfs H = 19' V = 350 acre-ft

V available for storage = 1160 - 349 acre-ft

$$Q_{p_2}(Trial) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

$$= 110{,}100\left(1 - \frac{349}{1160}\right)$$

$$= 76875 \text{ cfs} \quad H = 18.5' \quad V = 267 - 1 = 266$$

$$Q_{p_2} = Q_{p_1}\left(1 - \frac{V_{av}}{S}\right) \quad \left(\frac{349 + 266}{2} = 308\right)$$

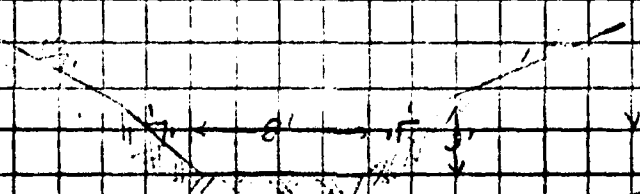
$$= 110{,}100\left(1 - \frac{308}{1160}\right)$$

$$= 80{,}900 \text{ cfs} \quad H = 19'$$

Pre-failure Stage = 2.7'
Failure Stage = 19.0'
Rise in Stage = 16.3'

Downstream Reach 1500 - 3500' below dam

Approximate Cross-section:



$$V = \frac{1.49}{n} K^{2/3} S^{1/2}$$

S = 0.060

n = .10 (brush), .04 stream

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 13 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by DRB Checked by SDM Date 10-14-80

Downstream Reach 1500-3000' below dam

Stream channel

H	A	P	R	V	Q
1	9	10.83	.83	8.62	78
3	33	16.49	2.00	15.49	511
4	47	"	2.85	19.62	922
6	75	"	4.55	26.80	2010
8	103	"	6.25	33.11	3410
10	131	"	7.95	38.37	5027
12	159	"	9.64	44.20	7025
14	187	"	11.34	49.26	9211
16	215	"	13.09	54.07	11635
18	243	"	14.74	58.67	14256
20	271	"	16.44	63.05	17089
22	299	"	18.14	67.36	20142
23	313	"	19.00	69.45	21739

Stream bank

H	A	P	R	V	Q
4	10	20.1	.50	2.45	25
6	90	40.2	1.93	5.10	459
8	250	100.5	2.49	7.17	1792
10	494	140.7	3.48	8.91	4395
12	710	160.9	4.93	10.72	8529
14	1010	221.1	5.47	12.12	14167
16	[illegible]	261.3	6.47	13.55	22900
18	2520	321.5	7.96	14.91	33640
20	3280	341.7	9.46	16.20	46329
22	3610	381.9	9.45	17.45	62978
23	4000	402.0	9.95	18.06	72232

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 14 of 21

Subject Inspection of non-federal dams

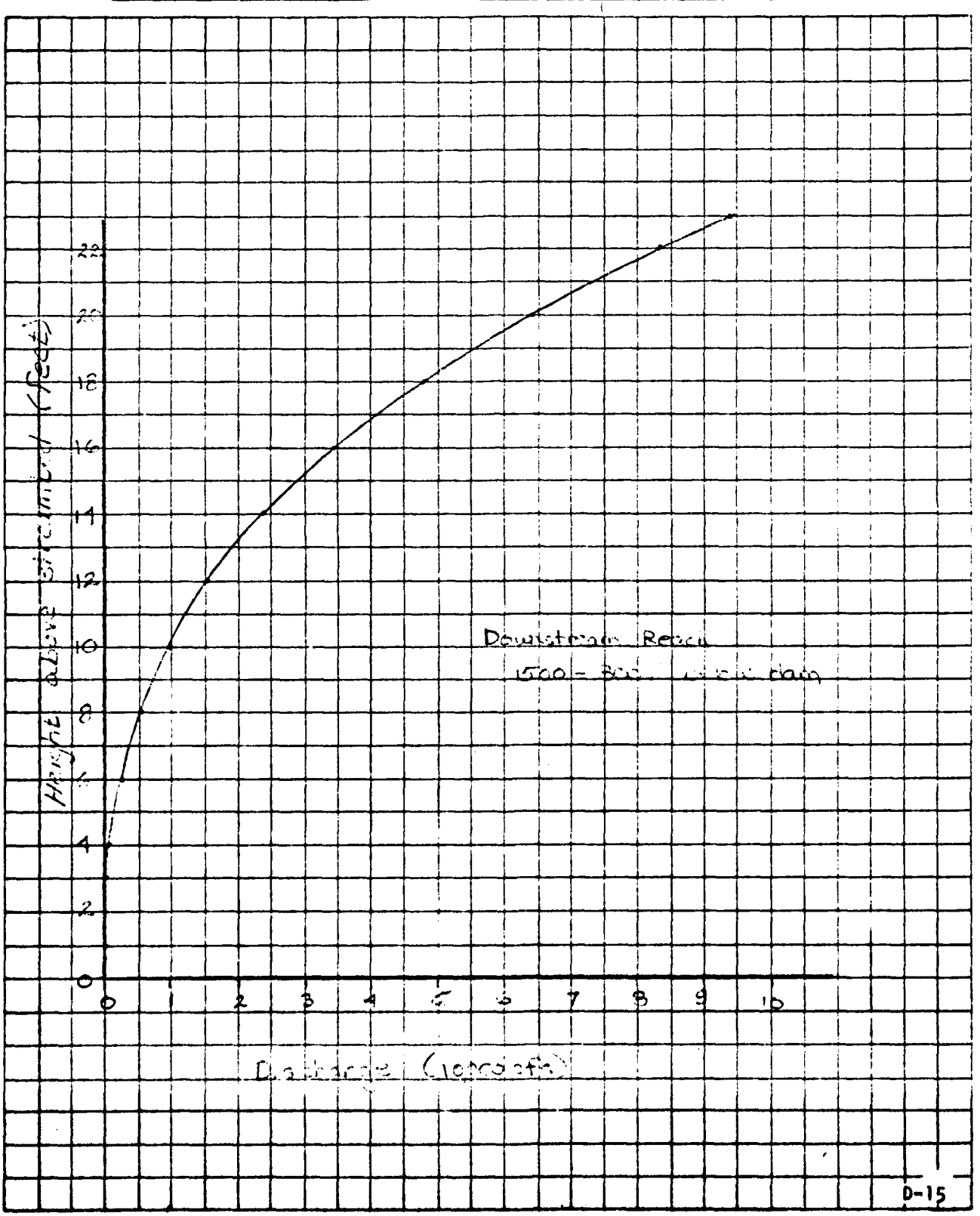
Computation Kent Pond

Job No. 953-05 I

Computed by MEB

Checked by SDA

Date 10-14-



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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 15 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by MFB Checked by [illegible] Date 10-14-80

Downstream Reach 15 ft + 2 ft below dam

Reservoir Storage @ time of [illegible] 116 acre-ft

Pre-failure flow = 198 cfs H = 1.6' V = .5 acre-ft

Failure flow = 87,100 cfs (from d = 1500' below dam) H = 21.7

V = 130.1 acre-ft

V_1 available for storage = 130.5 - .5 = 130 acre-ft

$$Q_{f2}(\text{trial}) = Q_{p1}\left(1 - \frac{V_1}{S}\right)$$

$$= 80,200\left(1 - \frac{130}{1100}\right)$$

$$= 71,234 \text{ cfs} \qquad H = 20.9 \quad V = 118.2 \text{ acre-ft}$$

$$Q_{f2} = Q_{p1}\left(1 - \frac{V_2}{S}\right) \qquad \frac{118.2 + 130}{1100} = .226$$

$$= 80,200\left(1 - .226\right)$$

$$\approx 72,200 \text{ cfs}$$

Pre-failure stage = 1.6'

Failure stage = 20.9'

Freeboard at dam = 13.2'

This is a light duty road crossing at the downstream embankment toe. The bridge deck is approximately 5 feet above the streambed and would be destroyed in the event of dam failure.

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 16 of 31

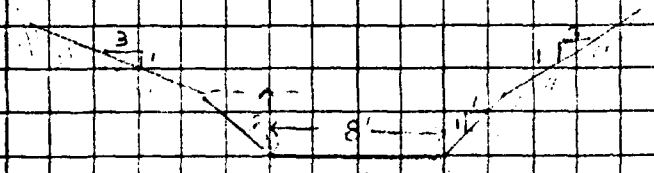
Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by MSP Checked by SDM Date 10-14-93

Downstream Reach 3[illegible] - 3[illegible]' [illegible]

Approximate Cross-section:



$V = \frac{1.49}{n} R^{2/3} S^{1/2}$

S = .23

n = .04 stream bed

[illegible] for banks (Table [illegible])

Stream bed

H	A	P	R	V	Q
1	9	10.83	.83	[illegible].69	132
3	33	16.49	2.00	8.59	371
4	47	"	2.85	[illegible]3.40	1570
6	75	"	4.55	[illegible]5.62	3421
8	103	"	6.25	[illegible]7.54	[illegible]2[illegible]5
10	131	"	7.95	[illegible]6.16	[illegible]3[illegible]7
12	159	"	9.64	75.23	11[illegible]9
14	187	"	11.34	[illegible]3.[illegible]	15[illegible]5
16	215	"	13.04	92.25	19791
18	243	"	14.74	99.[illegible]	24[illegible]79
20	271	"	16.44	107.41	29[illegible]3
22	299	"	18.14	114.69	34292
24	327	"	19.84	121.74	3[illegible]819
26	355	"	21.53	128.[illegible]	4[illegible]5[illegible]

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 17 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by MEB Checked by SDM Date 10-14-80

Downstream Reach 3000 - 3750' below dam

Stream Banks

H	A	P	R	V	Q
4	3	6.32	.47	4.04	12
6	27	12.97	1.42	8.41	227
8	75	31.62	2.37	11.82	886
10	147	44.27	3.32	14.78	2174
12	243	56.92	4.27	17.49	4250
14	363	69.57	5.22	19.99	7257
16	507	82.22	6.17	22.35	11330
18	675	94.87	7.12	24.58	16594
20	867	107.52	8.04	26.72	23169
22	1083	120.17	9.0	28.75	31169
24	1323	132.82	9.96	30.77	40704
26	1587	145.46	10.91	32.69	51879

Reservoir storage @ time of failure = 160 acre-ft

Pre-failure flow = 198 cfs H = 1.2' V = .2 acre-ft

Failure flow = 72 200 cfs H = 22.9' V = 25.8 acre-ft

V_1 available for storage = 25.8 - .2 = 25.6 acre-ft

Q_{P2} (Trial) $= Q_{P1}\left(1 - \frac{V}{S}\right)$

$= 72200\left(1 - \frac{25.6}{1160}\right)$

$= 70,600$ cfs H = 22.8' V = 25.6 - .2 = 25.4

$Q_{P2} = Q_{P1}\left(1 - \frac{V_{av}}{S}\right)$

$= 72\,200\left(1 - \frac{25.5}{1160}\right)$

$= 70\,600$ cfs H = 22.7'

The [illegible] plans (the [illegible] will be used) has a sill approx. 10' above [illegible] and may be floated to a depth of almost 13' above the sill in the event of failure.

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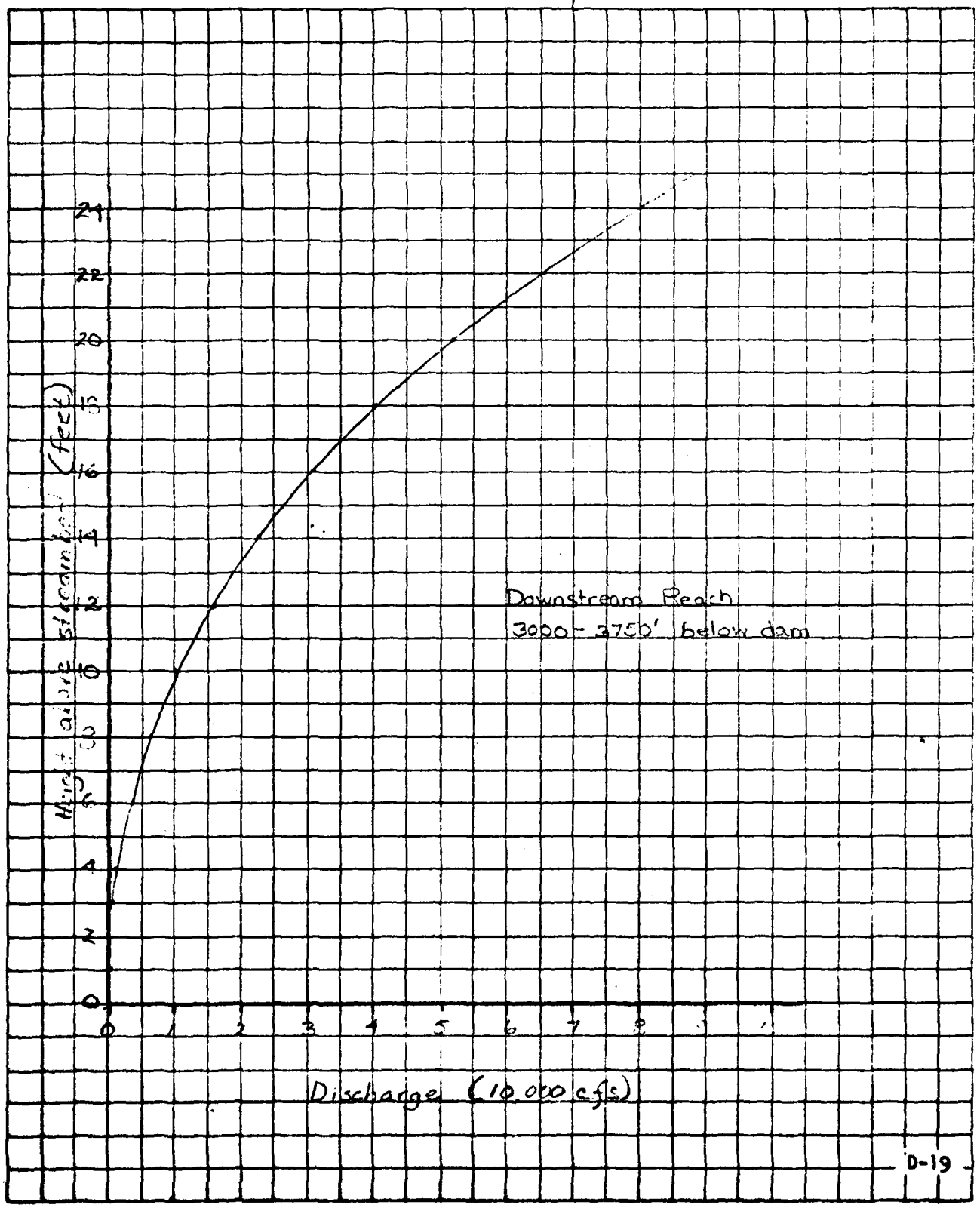
JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 18 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05I

Computed by MEP Checked by SDM Date 12-14-80



JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 19 of 31

Subject Inspection of non-federal dams

Computation Kent Pond

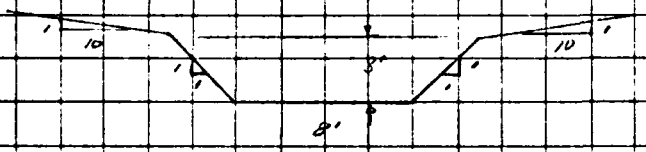
Job No. 253-05 I

Computed by SDH

Checked by

Date 3/26/81

Confluence Reach 3750' - 4550' below dam
(to confluence w/ Androscoggin)



$V = \frac{1.486}{n} R^{2/3} S^{1/2}$

$S = \frac{20}{640} = .025$

$n = .04$ stream bed

$n = .10$ stream bank

Storages

	A	P	R	K	Q	Storage
1	9	10.63	.83	518	77	.17
2	33	16.49	2.00	1234	308	.61
4	117	"	2.85	11.85	557	.86
6	215	"	4.58	16.21	1216	1.38
8	103	"	6.24	20.0	2060	1.89
10	131	"	7.94	23.5	3079	2.41
12	156	"	9.56	26.70	4219	2.90
14	187	"	11.34	29.69	5589	3.45
16	215	"	13.04	32.82	7056	3.95
18	243	"	14.74	35.63	8658	4.46
20	271	"	16.45	38.32	10,520	4.98
30	411	"	24.92	50.65	20,819	7.55

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

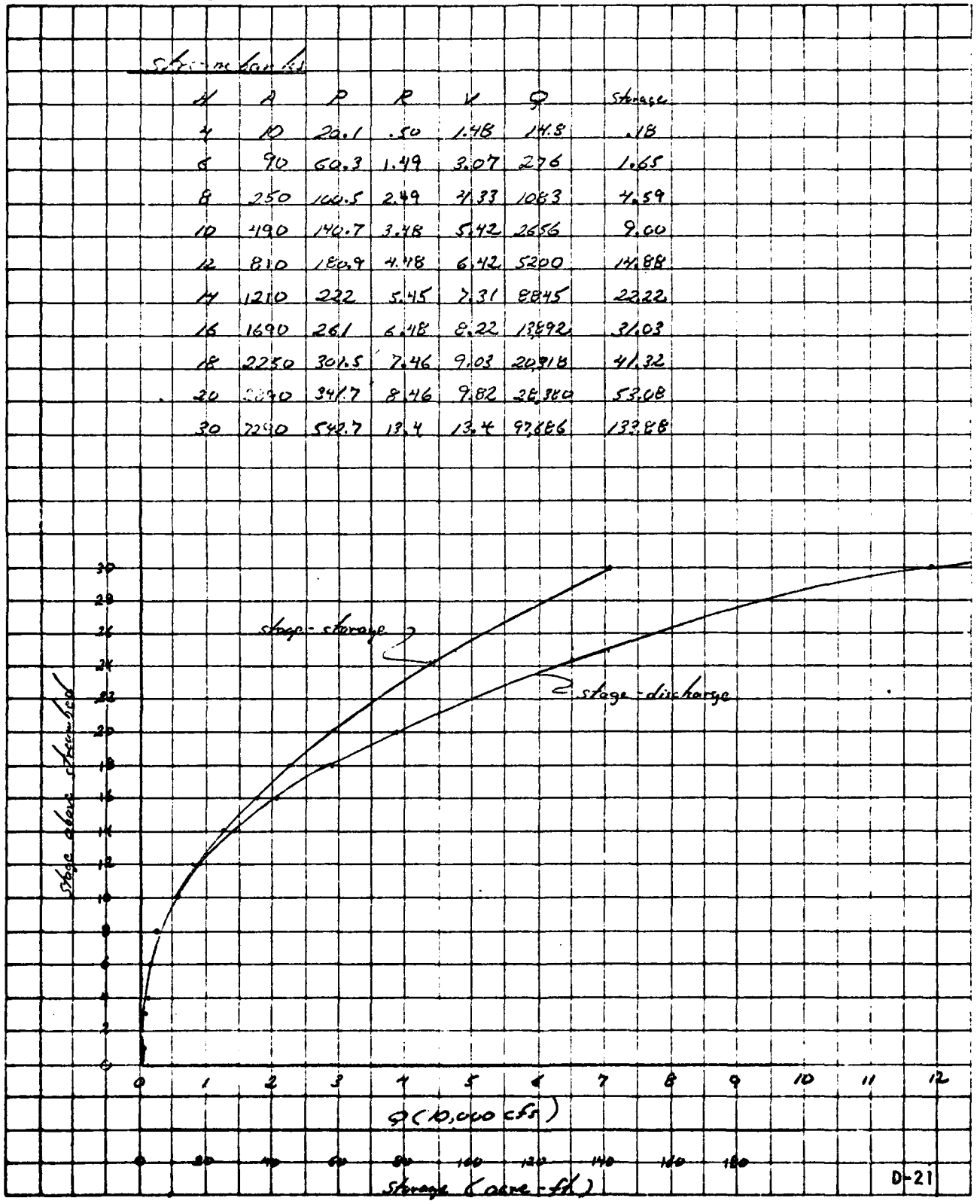
Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by SDK Checked by Date 3/26/81

Stream flow

H	A	P	R	V	Q	Storage
4	10	20.1	.50	1.48	14.8	.18
6	90	60.3	1.49	3.07	276	1.65
8	250	100.5	2.49	4.33	1083	4.59
10	490	140.7	3.48	5.42	2656	9.00
12	810	180.9	4.48	6.42	5200	14.88
14	1210	222	5.45	7.31	8845	22.22
16	1690	261	6.48	8.22	13892	31.03
18	2250	301.5	7.46	9.03	20318	41.32
20	2890	341.7	8.46	9.82	28380	53.08
30	7290	542.7	13.4	13.4	97866	133.88



JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 21 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by SDM Checked by Date 3/27/81

Reservoir Storage @ time of failure = 1160 acre-ft

Pre-failure flow = 198 cfs H = 22' V = .4 acre-ft

Failure flow = 70,600 cfs (from 3040'-3750' reach)

H = 25', V = 90 acre-ft

V available for storage = 90 - .4 = 89.6 acre-ft

Q_{P_2} (trial) = $Q_{P_1}\left(1-\frac{89.6}{1160}\right)$ = 65,147 cfs

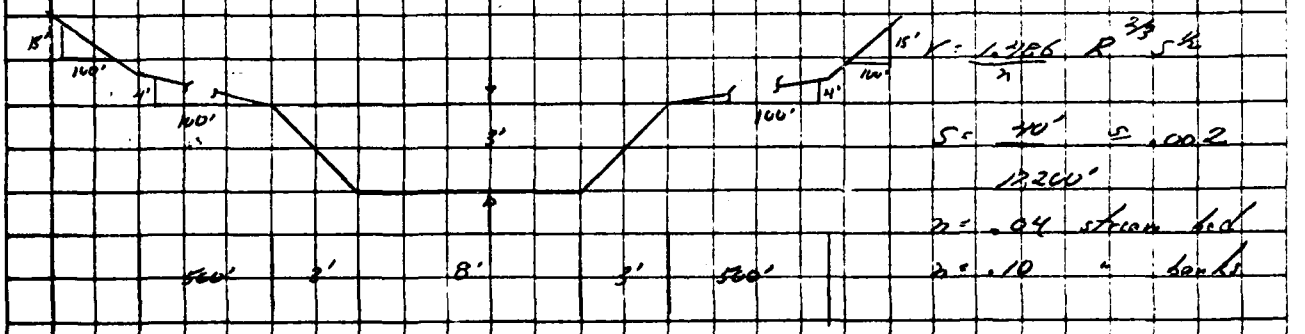
H = 24.4', V = 88 acre-ft - .4 acre-ft = 87.6 ac-ft

$Q_{P_2} = Q_{P_1}\left(1-\frac{89.6-87.6}{1160}\right)$ = 65,207 cfs H = 24.4'

4550 - 12,550

Downstream Reach 4550' - 12,550' below dam

divide into 8 1000' reaches



$V = \frac{1.486}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$

$S = \frac{40'}{13200'} = .002$

n = .04 stream bed

n = .10 " banks

Stream bed

H	A	P	R	V	Q	Storage
1	9	10.83	.83	1.46	13	.2
3	33	16.49	2.00	2.6	86	.76
4	47	"	2.85	3.35	157	1.1
6	75	"	4.55	4.58	344	1.7
8	103	"	6.24	5.66	583	2.4
10	131	"	7.94	6.65	871	3
12	158	"	9.58	7.55	1193	3.6
14	187	"	11.33	8.45	1580	4.3
16	215	"	13.04	9.28	1995	4.9
18	243	"	14.74	10.08	2449	5.6
20	271	"	16.43	10.84	2938	6.2

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 22 of 31

Subject Inspection of mini-flood dams

Computation Kent Pond Job No. 953-05 I

Computed by SDY Checked by Date 4/7/81

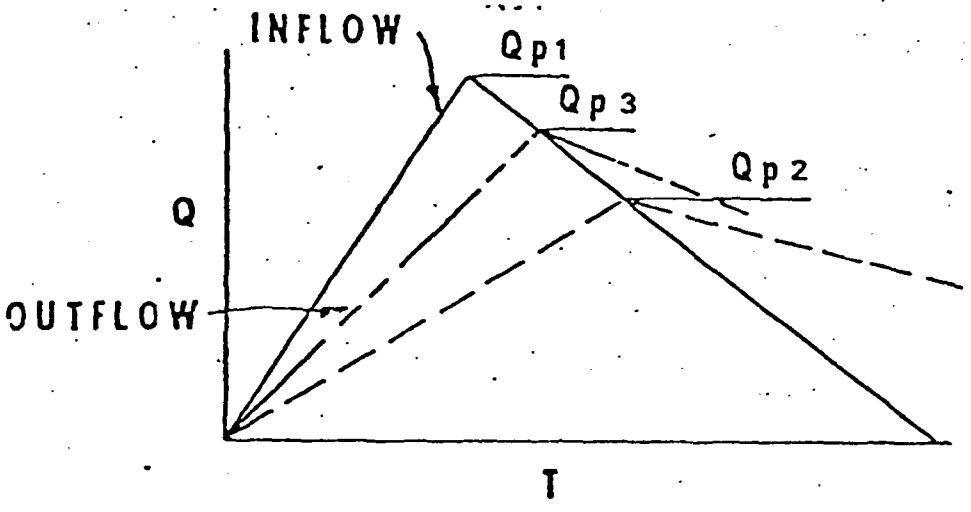
Stream data (cont'd)

	N	A	P	R	K	Q	Storage
	28	313	16.49	18.98	1193	3734	7.2
	26	355	"	21.53	1299	4611	8.1
	29	397	"	24.08	1400	5559	9.1

Stream data (cont'd)

	N	A	P	R	K	Q	Storage
	4	50	50	1	.67	33.5	1.1
	6	225	150	1.5	.87	196	5.2
	8	625	250	2.5	1.23	769	14.3
	10	1225	350	3.5	1.54	1887	28.1
	12	2025	450	4.5	1.82	3686	46
	14	3025	550	5.5	2.08	6292	69
	16	4225	650	6.5	2.33	9844	97
	18	5625	750	7.5	2.56	14,400	129
	20	7225	850	8.5	2.79	20,158	166
	23	10,000	1001	10	3.11	31,140	230
	26	13,102	1141	12.59	3.63	47,560	301
	29	16,324	1283	15.09	4.10	66,847	375

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Q_{p1}) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Q_{p1}".

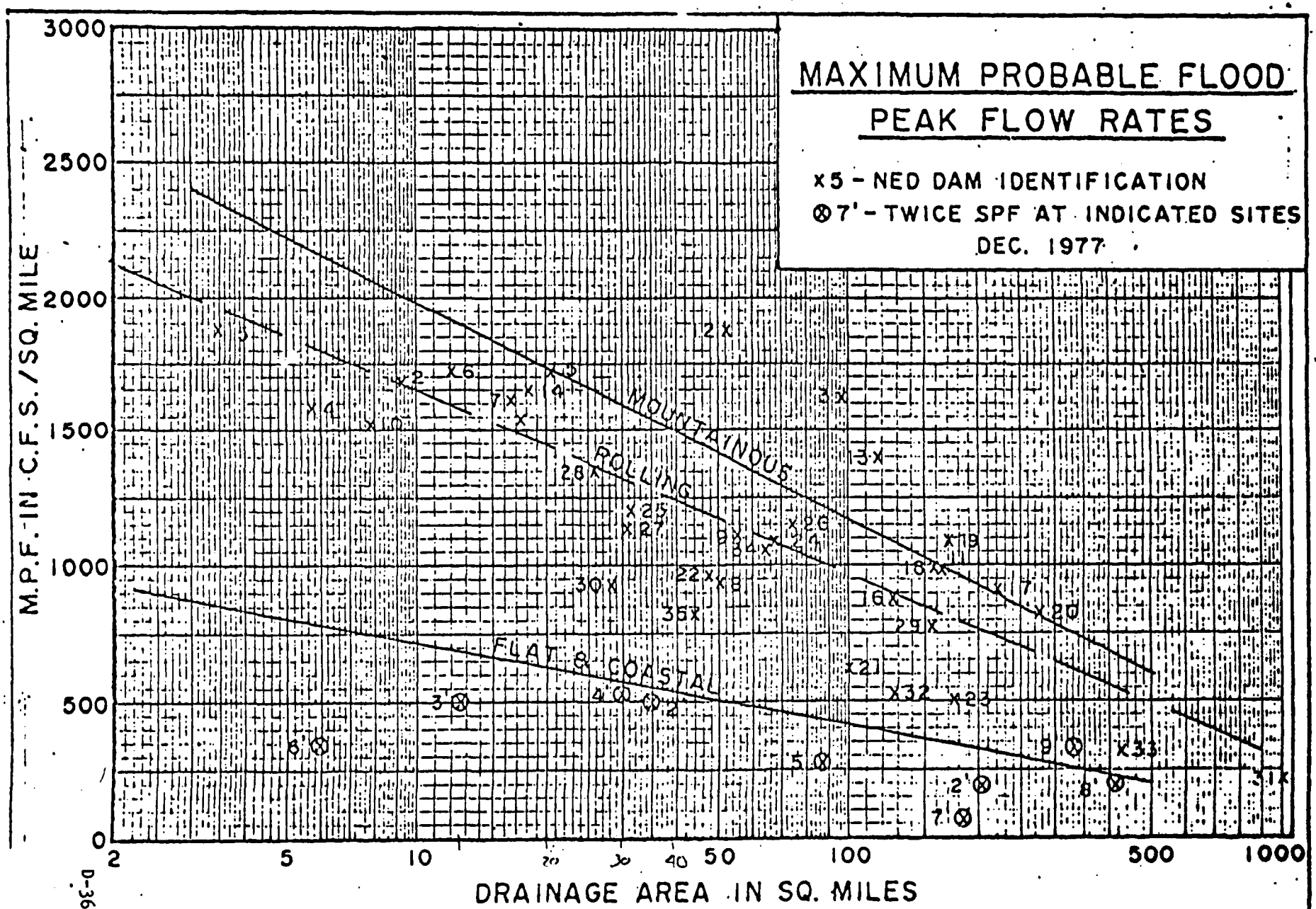
b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore:

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Q_{p2}"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Q_{p3}".


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
3000
2500
2000
1500
1000
500
0
2
5
10
20
30
40
50
100
500
1000
DRAINAGE AREA IN SQ. MILES
MOUNTAINOUS
ROLLING
FLAT & COASTAL

MAXIMUM PROBABLE FLOWS BASED ON TWICE THE STANDARD PROJECT FLOOD (Flat and Coastal Areas)

River	SPF (cfs)	D.A. (sq. mi.)	MPF (cfs/sq. mi.)
1. Pawtuxet River	19,000	200	190
2. Mill River (R.I.)	8,500	34	500
3. Peters River (R.I.)	3,200	13	490
4. Kettle Brook	8,000	30	530
5. Sudbury River.	11,700	86	270
6. Indian Brook (Hopk.)	1,000	5.9	340
7. Charles River.	6,000	184	65
8. Blackstone River.	43,000	416	200
9. Quinebaug River	55,000	331	330

MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

	Project	Q (cfs)	D.A. (sq. mi.)	MPF cfs/sq. mi.
1.	Hall Meadow Brook	26,600	17.2	1,546
2.	East Branch	15,500	9.25	1,675
3.	Thomaston	158,000	97.2	1,625
4.	Northfield Brook	9,000	5.7	1,580
5.	Black Rock	35,000	20.4	1,715
6.	Hancock Brook	20,700	12.0	1,725
7.	Hop Brook	26,400	16.4	1,610
8.	Tully	47,000	50.0	940
9.	Barre Falls	61,000	55.0	1,109
10.	Conant Brook	11,900	7.8	1,525
11.	Knightville	160,000	162.0	987
12.	Littleville	98,000	52.3	1,870
13.	Colebrook River	165,000	118.0	1,400
14.	Mad River	30,000	18.2	1,650
15.	Sucker Brook	6,500	3.43	1,895
16.	Union Village	110,000	126.0	873
17.	North Hartland	199,000	220.0	904
18.	North Springfield	157,000	158.0	994
19.	Ball Mountain	190,000	172.0	1,105
20.	Townshend	228,000	106.0(278 total)	820
21.	Surry Mountain	63,000	100.0	630
22.	Otter Brook	45,000	47.0	957
23.	Birch Hill	88,500	175.0	505
24.	East Brimfield	73,900	67.5	1,095
25.	Westville	38,400	99.5(32 net)	1,200
26.	West Thompson	85,000	173.5(74 net)	1,150
27.	Hodges Village	35,600	31.1	1,145
28.	Buffumville	36,500	26.5	1,377
29.	Mansfield Hollow	125,000	159.0	786
30.	West Hill	26,000	28.0	928
31.	Franklin Falls	210,000	1000.0	210
32.	Blackwater	66,500	128.0	520
33.	Hopkinton	135,000	426.0	316
34.	Everett	68,000	64.0	1,062
35.	MacDowell	36,300	44.0	825

PRELIMINARY GUIDANCE

FOR ESTIMATING

MAXIMUM PROBABLE DISCHARGES

IN

PHASE I DAM SAFETY

INVESTIGATIONS

New England Division
Corps of Engineers

March 1978

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 31 of 31

Subject Inspection of non-federal dams

Computation Kent Pond

Job No. 953-05-E

Computed by SDA Checked by Date 7/14/81

Summary

a) Peak Failure Outflows

Q_p = 110,100 cfs flow to Kent Brook

Q_p = 2,444 cfs flow from emergency spillway

b) Approximate pre-failure stages

Just below dam	2.7'	
3750' D/S	1.2'	(at house)
4450' D/S	2.1'	(at Onanguechee)
5550' D/S	3.2'	(at Fish Haven (culvert))
12550' D/S	4.4'	(at bridge)
12850' D/S	4.4'	(at house trailer)

c) Approximate post-failure stage

		structure el. above river bed
Just below dam	19.0'	–
3750' D/S	22.8'	10'
4450' D/S	24.4'	–
5550' D/S	25.5'	9' ± Top of Rd.
12550' D/S	17.5'	14' ± Top of Rd.
12850' D/S	17'	6' ±

d) Rise in Stage

Just below dam	20.2'
3750' D/S	20.7'
4450' D/S	21.2'
5550' D/S	22.3'
12550 D/S	18.1'
12850 D/S	13'

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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Subject Inspection of non-Federal Dams

Computation Kent Pond Job No. 953-05 I

Computed by SDY Checked by _____ Date 4/14/81

Reach 12550 - 13550

Failure flow = 14,525 cfs (from reach 11550 - 12550)

W = 12.5', V = 180 acre-ft - 2.2 = 177.8

$Q_2 = Q_1 \left(1 - \frac{177.8}{180}\right)$ = 12,924 cfs

W = 17', V = 115 acre-ft - 2.2 = 112.8

$Q_2 = Q_1 \left(1 - \frac{12.5 W_1 + 112.8 W_2}{180}\right)$ = 13,019 cfs

say 13,000 cfs

W = 17'

House Trailer Pad at 6'±

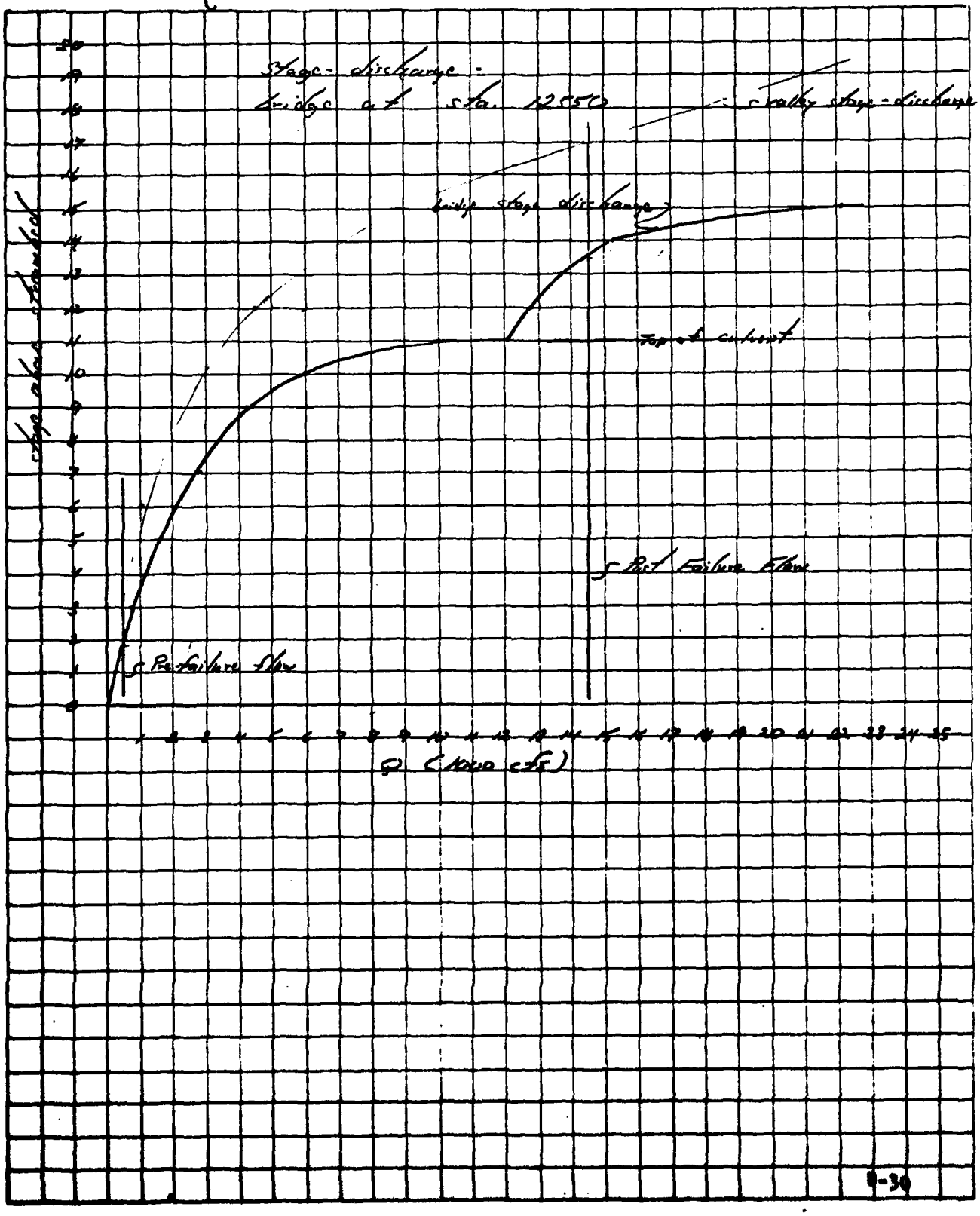
JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 29 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05E

Computed by SDM Checked by Date 4/14/81



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JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05-E

Computed by SDM Checked by _____ Date 4/14/81

Highway Bridge @ Sta. 12550 (continued)

Surcharge Flow

$Q = CA\sqrt{2gh}$ $C = .8$

multiplier for 45° riser = 1.41

H	A	Δh	Q
11	8IN	7.64	12,058
12	"	7.8	12,594
13	"	8.2	13,198
14	"	8.6	13,603
15	4	9	14,080
16	4	9.4	14,542
17	4	9.8	14,990

Weir Flow

$Q = CLH^{3/2}$ $C = 2.5$

	H	L	Q	H	L	Q	H	L	Q	H	L	Q	ΣQ
12	.67	200	140										140
13	1.3	400	593										593
14	2	400	1497										1497
15	3	4	7794	1	74	195	.67	50	69	.67	100	187	8185
16	4	4	12040	2	4	523	1.34	100	388	1.34	200	776	13,687
17	5	4	16,771	3	4	961	2.34	4	895	2.34	4	1790	20,417

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

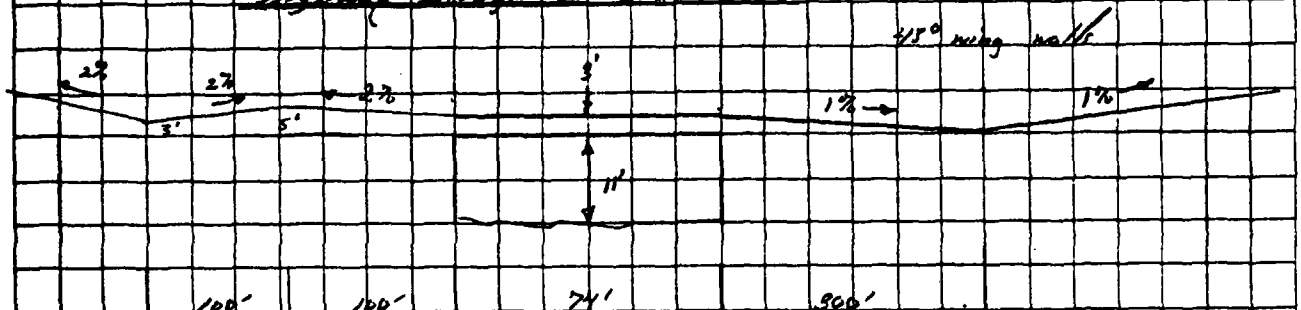
Sheet 27 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-051

Computed by SDH Checked by Date 4/8/81

Highway Bridge @ Sta 12+50



$Q = CA\sqrt{2g\Delta h}$ King's formula 4-37

$C = .8$

$h_1 = 4'$

$h_2 = 4(6) = 66'$

$\Delta h = 7.4'$

Multiplier M for 45° wingwalls M King, p. 4-24

Max. Q:

$Q = (10.6)(.8)(6+4)\sqrt{64.4(7.4)} = 12,058$ cfs

Manning's

$V = \frac{1.486}{n} R^{2/3} S^{1/2}$ $S = .002$

$n = .04$

#	A	P	R	V	Q
1	74	76	.97	1.63	121
3	222	80	2.7	3.23	717
5	370	84	4.4	4.48	1658
7	518	88	5.9	5.46	2828
9	666	92	7.2	6.23	4153

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by SDK Checked by Date 4/7/81

Reach 9550-10550

Failure flow = 21,229 cfs (from reach 8550 - 9550)

W = 19', V = 150 acre-ft - 2.2 = 147.8

Q_{P_2} (this) = $Q_{P_1}\left(1 - \frac{147.8}{1160}\right)$ = 18,524 cfs

W = 18.5', V = 145 acre-ft - 2.2 = 142.8

$Q_{P_2} = Q_{P_1}\left(1 - \frac{147.8 + 142.8}{2} / 1160\right)$ = 18,570 cfs

Reach 10550-11550

Failure flow = 18,570 cfs (from reach 9550-10550)

W = 18.5', V = 145 acre-ft - 2.2 = 142.8

Q_{P_2} (this) = $Q_{P_1}\left(1 - \frac{142.8}{1160}\right)$ = 16,284 cfs

W = 18', V = 135 acre-ft - 2.2 = 132.8

$Q_{P_2} = Q_{P_1}\left(1 - \frac{142.8 + 132.8}{2} / 1160\right)$ = 16,364 cfs

Reach 11550-12550

Failure flow = 16,364 cfs (from reach 10550-11550)

W = 18', V = 135 acre-ft - 2.2 = 132.8

Q_{P_2} (this) = $Q_{P_1}\left(1 - \frac{132.8}{1160}\right)$ = 14,491 cfs

W = 17.5', V = 130 acre-ft - 2.2 = 127.8

$Q_{P_2} = Q_{P_1}\left(1 - \frac{127.8 + 132.8}{2} / 1160\right)$ = 14,525 cfs

Say 14,500 cfs

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 953-05 I

Computed by SDK Checked by Date 4/7/81

Reach 6550 - 7550

Failure flow = 36,975 cfs (from reach 5550-6550)

W = 23.5', V = 245 acre-ft

V available for storage = 245 - 2.2 = 242.8 acre-ft

Q_{P2} (trial) = $Q_{P1}\left(1 - \frac{242.8}{1160}\right)$ = 29,236 cfs

W = 21.5', V = 205 acre-ft - 2.2 = 199.8

$Q_{P2} = Q_{P1}\left(1 - \frac{\frac{242.8+199.8}{2}}{1160}\right)$ = 29,921 cfs

Reach 7550 - 8550

Failure flow = 29,921 cfs (from reach 6550 - 7550)

W = 22', V = 210 acre-ft - 2.2 = 207.8

Q_{P2} (trial) = $Q_{P1}\left(1 - \frac{207.8}{1160}\right)$ = 24,561 cfs

W = 21', V = 190 acre-ft - 2.2 = 187.8

$Q_{P2} = Q_{P1}\left(1 - \frac{\frac{207.8+187.8}{2}}{1160}\right)$ = 24,819 cfs

Reach 8550 - 9550

Failure flow = 24,819 cfs (from reach 7550 - 8550)

W = 21', V = 190 acre-ft - 2.2 = 187.8 acre-ft

Q_{P2} (trial) = $Q_{P1}\left(1 - \frac{187.8}{1160}\right)$ = 20,800 cfs

W = 19', V = 150 acre-ft - 2.2 = 147.8

$Q_{P2} = Q_{P1}\left(1 - \frac{\frac{187.8+147.8}{2}}{1160}\right)$ = 21,229 cfs

JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 24 of 31

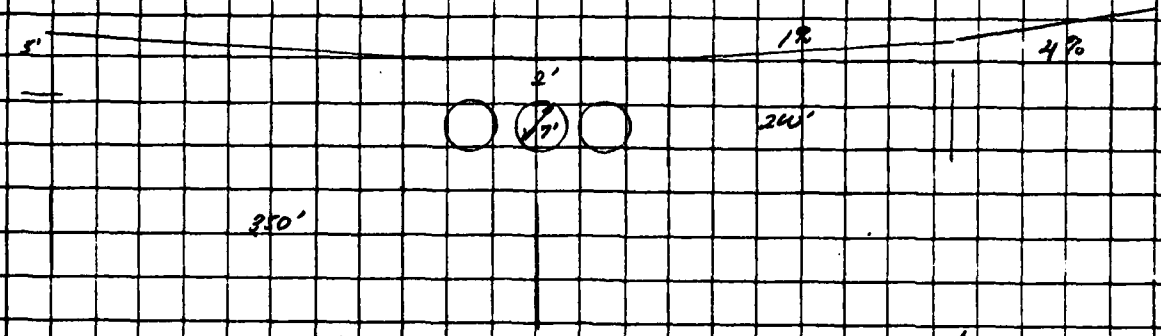
Subject Inspection of non-federal dams

Computation Mott Pond

Job No. 853-05 I

Computed by SDK Checked by Date 4/7/81

3 barrel culvert @ 6550' elev



Pre-failure flow = 198 cfs ÷ 66 cfs/culvert

Manning n = .025

S = .002

Q_p = 185 cfs

$\frac{Q}{Q_p}$ = .36

$\frac{y}{D_p}$ = .46

∴ Pre-failure stage = .46(7') = 3.2'

Pre-failure stage = 25.5' (stage-discharge curve)

Stock 5500-6550

Failure flow = 47,726 cfs (flow 5500'-5500' incr.)

H = 25.5', V = 290 acre-ft

V, available for storage = 290 - 2.2 = 287.8 acre-ft

Q_2 (trial) = $Q_p\left(1 + \frac{287.8}{1160}\right)$ = 95,885 cfs

H = 23', V = 257 acre-ft - 2.2 = 254.8 acre-ft

$Q_2 = Q_p\left(1 - \frac{(287.8 + 254.8)}{2} / 1160\right)$ = 36,975 cfs

D-25

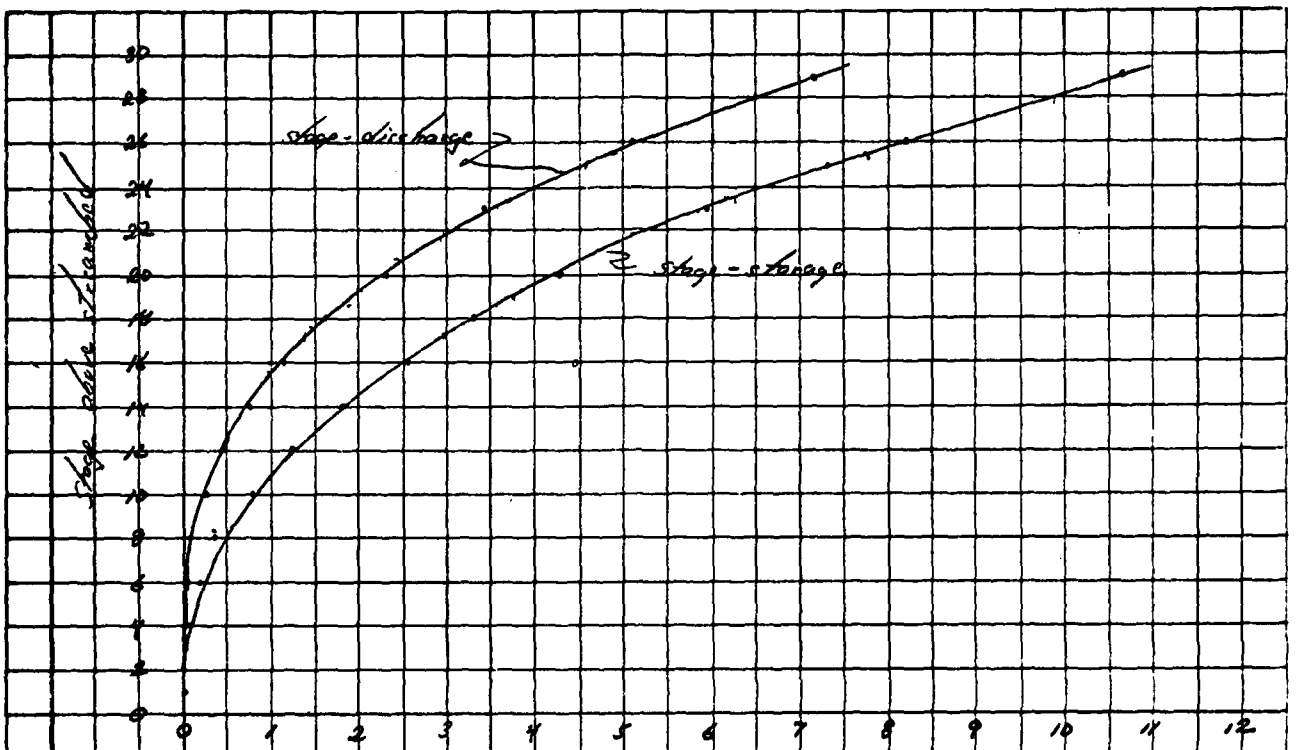
JAMES W. SEWALL COMPANY, OLD TOWN, MAINE
Civil and Sanitary Engineers

Sheet 23 of 31

Subject Inspection of non-federal dams

Computation Kent Pond Job No. 853-05 E

Computed by SDM Checked by Date 4/7/81



Road 4550 - 5550

Reservoir Storage @ time of failure = 1160 acre-ft.

Pre-failure flow = 198 cfs H = 4', V = 2.2 acre-ft.

Failure flow = 65,147 cfs (from 3750'-4550' reach)

H = 28', V = 348 acre-ft.

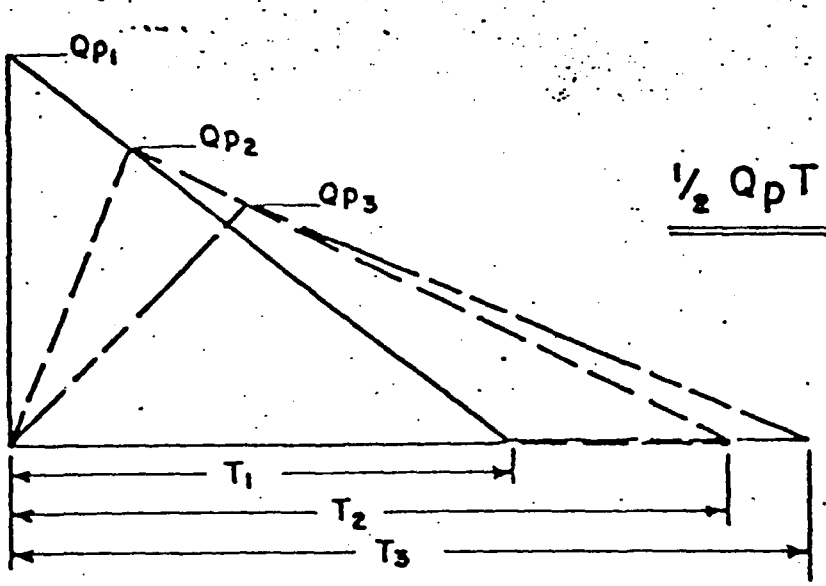
V, available for storage = 348 - 2.2 = 345.8 acre-ft

$$Q_{P_2}(\text{final}) = Q_{P_2}\left(1 - \frac{345.8}{1160}\right) = 45,726 \text{ cfs}$$

H = 25', V = 275 acre-ft. - 2.2 = 272.8 acre-ft

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{(345.8 + 272.8)}{1160}\right) = 47,726 \text{ cfs}$$

"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Q_{p_1} = \frac{8}{27} W_b \sqrt{g} Y_o^{3/2}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Q_{p_2}(\text{TRIAL}) = Q_{p_1}\left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Q_{p_2} = Q_{p_1}\left(1 - \frac{V_{AVG}}{S}\right)$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

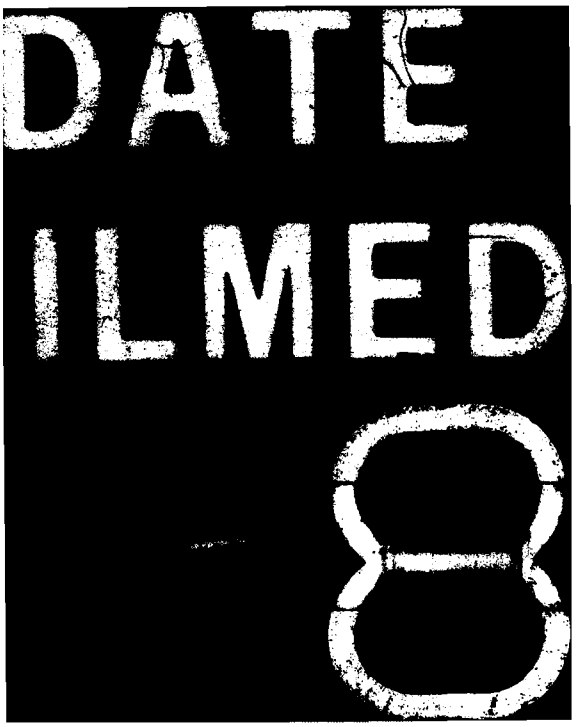
APRIL 1978

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME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